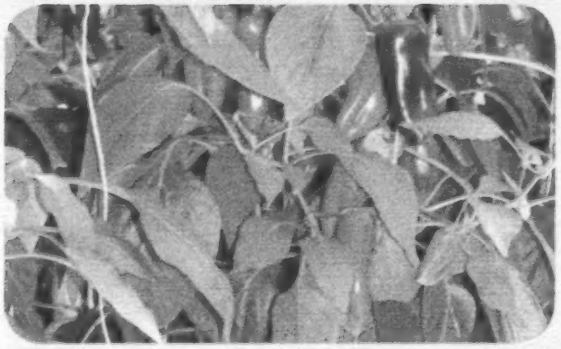
CROP PROTECTION GUIDE FOR GREENHOUSE VEGETABLES

2014–2015

Publication 835



Ministry of Agriculture,
Food and Rural Affairs

Ontario

Discard old editions of this publication. Each year the appropriate sub-committee of the Ontario Pest Management Research and Services Committee reviews the pesticides listed in this publication. To the best knowledge of the committee, at the time of printing, the pesticide products listed in this publication were:

- federally registered
- classified by the Ministry of the Environment and Climate Change (MOECC)

The information in this publication is general information only. The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) does not offer any warranty or guarantee, nor does it assume any liability for any crop loss, animal loss, health, safety or environmental hazard caused by the use of a pesticide mentioned in this publication.

This publication lists a number of brand names of pesticides. It is neither an endorsement of the product nor a suggestion that similar products are ineffective.

The Pesticide Label

Consult each product label before you use a pesticide. The label provides specific information on how to use the product safely, hazards, restrictions on use, compatibility with other products, the effect of environmental conditions, etc.

The pesticide product label is a legal document. It is against the law to use the product in any other way.

Federal Registration of Pesticide Products

The Pest Management Regulatory Agency (PMRA) of Health Canada registers pesticide products for use in Canada based on following an evaluation of scientific data to ensure that the product has merit and value, and the human health and environmental risks associated with its proposed use are acceptable.

1. **Full Registration**

   Pesticide registrations are normally granted for a period of five years, subject to renewal.

2. **Conditional Registration**

   Conditional registration may be granted for a specified, limited time period, where the registrant agrees to produce additional scientific or technical information, or the pesticide is used for emergency control of a serious pest outbreak.

Maximum Residue Limits

The PMRA has established maximum residue limits (MRLs) for pesticides. Processors or retailers may demand more restrictive limits. Growers should seek advice of their intended market to determine if more restrictive limitations apply. Keep accurate and up-to-date records on pesticide use in each crop.

Supplemental Labels

You MUST obtain a supplemental label and follow all the label directions when PMRA approves new uses for a registered pesticide that do not appear on the current label.

Examples of when you must use a supplemental label include:

- **Emergency Use Registration**
- **Minor Use Label Expansion**

You can obtain a copy of a supplemental label from the pesticide manufacturer or pesticide vendor, the grower association that sponsored the emergency registration or minor use, from OMAFRA or PMRA's Pest Management Information Service.

For more information on the federal registration status check the PMRA website at www.healthcanada.gc.ca/pmra or call 1-800-267-6315.

Regulation of Pesticides in Ontario

The MOECC is responsible for regulating pesticide sale, use, transportation, storage and disposal in Ontario. Ontario regulates pesticides by placing appropriate education, licensing and/or permit requirements on their use, under the Pesticides Act and Regulation 63/09.

All pesticides must be used in accordance with requirements under the *Pesticides Act* and Regulation 63/09, which are available on the e-laws website at www.e-laws.gov.on.ca or by calling ServiceOntario Publications Toll-Free number: 1-800-668-9938 or 416-326-5300.

Classification of Pesticides

The Ontario Pesticides Advisory Committee (OPAC) is responsible for reviewing and recommending to the MOECC, the classification of pesticide products before they can be sold or used in Ontario. Once approved by the MOECC, classified products are posted on the MOECC website: www.ontario.ca/moe.

Certification and Licensing

Growers and Their Assistants

For information about certification for growers and training for assistants, check the Ontario Pesticide Education Program website: www.opep.ca or call 1-800-652-8573.

Commercial Applicators (Exterminators) and Their Assisting Technicians

For more information about exterminator licensing and technician training, visit:

- The Ontario Pesticide Training and Certification website at www.ontariopesticide.com/index.cfm/home-page or call 1-888-620-9999 or 519-674-1575
- The Pesticide Industry Council's Pesticide Technician Program website at www.hort-trades.com or call 1-800-265-5656 or e-mail pic@hort-trades.com
- The Pesticide Industry Regulatory Council (PIRC) at www.pirc.ca.

Cette publication est aussi disponible en français.

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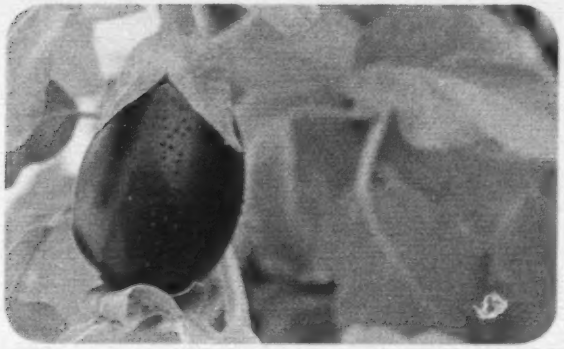

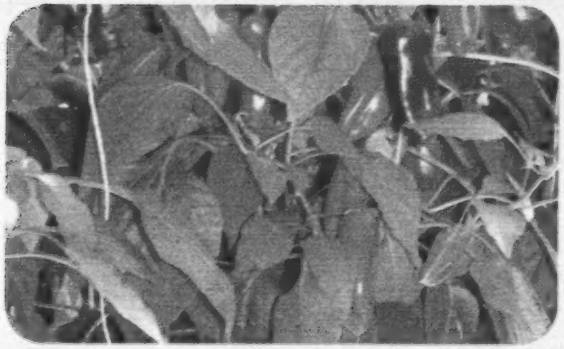

Ministry of Agriculture,
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Acknowledgements

The information contained in this publication has been peer reviewed.

If you need technical and business information, contact the

Agricultural Information Contact Centre at

1-877-424-1300

or ag.info.omafra@ontario.ca

If you are looking for greenhouse production information on the internet, check the OMAFRA website at
www.ontario/crops

This publication contains all pesticide products that have been registered as of July, 2014 for use on greenhouse vegetable crops. For more comprehensive information on pest management strategies, pest life histories and diseases and on information related to production of the major greenhouse vegetables in Ontario, see OMAFRA Publication 836, *Growing Greenhouse Vegetables in Ontario*. Information on ordering OMAFRA publications is found on the inside back cover of this book. Supplements to this publication will be posted to the OMAFRA website.

Cover Images

FRONT: Top left: orange, yellow and red mini-peppers
Middle left: greenhouse eggplant
Middle right: greenhouse cherry tomatoes
Bottom left: greenhouse mini red peppers
Bottom middle: greenhouse mini cucumbers
Bottom right: mixed assortment of greenhouse vegetables

BACK: Large: banker plant used for rearing aphid parasitoids
Small top right: cucumber flower distorted due to thrips feeding
Small middle right: diseased cucumber stem
Small bottom right: immature stages of ladybeetles on pepper plant

Introduction

Products Listed in This Book

This book lists products that are registered for use on greenhouse vegetable, and contains registrations obtained up to July, 2014. Products are listed according to pest for each greenhouse vegetable crop. Information within the tables is based on labels approved by the Pest Management Regulatory Agency and is included so that growers can consider options when implementing their pest management programs. When selecting a product to use, growers should consider several factors including compatibility with beneficial insects, safety to the user, pre-harvest and re-entry intervals and resistance management.

Resistance Management Strategies

Different pesticides control pests in different ways. This is called the mode of action. Pesticides are grouped into chemical families/groups based on their mode of action. Using the same pesticide with the same mode of action season after season or several times within the same season could result in the target pest becoming resistant to the chemical family. A pest can develop resistance to one chemical family but still be very susceptible to another. Therefore, to reduce the risk of a pest developing resistance, use the following strategies:

- Avoid repeated use of pesticides from the same chemical subgroup (indicated by the IRAC and FRAC Mode of Action Group number — see Appendix D). For insecticides, rotate between chemical groups/families. Use products within one group only for the duration of one generation of the target insect before switching to another group for the following generation.
- Only use pesticides when necessary and integrate them as much as possible with other management strategies in an Integrated Pest Management (IPM) program. For example, to manage insect and mite pests, major strategies should include crop monitoring and biological control. Cultural controls such as sanitation and mass trapping should also be considered to minimize pesticide use and thereby reduce the risk of a pest developing resistance to a pesticide. To manage diseases, major strategies should include sanitation, maintaining optimum levels of moisture and nutrients in the growing media and manipulation of environmental parameters (e.g., relative humidity and temperature) to minimize conditions that favour development of disease. For further details on insect pests, mite pests and diseases, as well as IPM strategies for managing them, refer to OMAFRA Publication 836, *Growing Greenhouse Vegetables in Ontario.*
- Do not exceed the total number of applications allowed per year for each product. Do not apply the product at rates lower than the recommended rate on the label.
- Monitor recently treated pest populations for signs of resistance.
- See the pesticide label for more information on resistance management. For more information on resistance management strategies or IPM options for a specific pest, contact your local OMAFRA specialist or IPM consultant.

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1. Using Pesticides in Ontario

The information in this chapter is updated regularly. For up-to-date information, visit www.ontario.ca/usingpesticides. Some of the information in this generic chapter may not apply to all crops.

Read the label before use.
Product labels may change.
Review the *Grower Pesticide Safety Course Manual*.
Keep detailed spray records.

Federal Registration of Pesticides

Before a pesticide can be sold or used in Ontario, it must be registered under the federal *Pest Control Products Act* (PCP Act) and be classified under the provincial *Pesticides Act*. The Pest Management Regulatory Agency (PMRA) of Health Canada registers pesticides for use in Canada following an evaluation of scientific data to ensure that the product has merit and value. It also ensures that any human health and environmental risks associated with its proposed uses are acceptable.

The PMRA re-evaluates registered pesticides to determine whether today's health and environmental protection standards are still met when the pesticide is used according to the label. Outcomes of a re-evaluation can be:

- no change to the registration
- amendments to the label (e.g., changes to personal protective equipment requirements, restricted entry intervals, buffer zones)
- modifications to existing Maximum Residue Limits (MRLs)
- elimination or phasing-out of certain uses or formulations
- removal of the registration

The pesticide label is a legal document. It prescribes how the pesticide can be legally used. Labels for all registered pesticides are under "Search Pesticide Labels" on the PMRA website at www.healthcanada.gc.ca/pmra. Ensure you have the most current label and are aware of any re-evaluation decisions.

Regulation of Pesticides in Ontario

Environment and Climate Change (MOECC) is responsible for regulating the sale, use, transportation, storage and disposal of pesticides in Ontario. Ontario regulates pesticides by placing appropriate education, licensing and/or permit requirements on their use, under the *Pesticides Act* and Regulation 63/09. All pesticides must be used in accordance with requirements under the *Pesticides Act* and Regulation 63/09, which are available on the e-laws website at www.ontario.ca/e-laws or by calling ServiceOntario at 1-800-668-9938 or 416-326-5300.

Classification of Pesticides

Before a federally registered pesticide can be sold or used in Ontario, it must be classified under the provincial *Pesticides Act*. The Ontario pesticide classification system consists of 11 classes. Ontario's Pesticides Advisory Committee (OPAC) is responsible for assessing new pesticide products and recommending to the MOECC the classification of these products. Pesticide products are classified on the basis of their toxicity, environmental and health hazard, persistence of the active ingredient or its metabolites, concentration, usage, federal class designation (e.g., domestic, commercial, restricted) and registration status. The provincial classification system provides the basis for regulating the distribution, availability and use of pesticide products in Ontario. Once approved by the MOECC, classified products are posted on the MOECC website at www.ontario.ca/pesticides.

Certification and Licensing

Growers and Their Assistants

Growers must be certified through the Grower Pesticide Safety Course in order to buy and use Class 2 and 3 pesticides on their farms. They do not require this certification to use Class 4, 5, 6 or 7 pesticides. For information about certification for growers and training for assistants to growers, visit the Ontario Pesticide Education Program website at www.opep.ca or call 1-800-652-8573.

Commercial Applicators (Exterminators) and Their Assisting Technicians

For more information about exterminator licensing and technician training, visit:

- the Ontario Pesticide Training and Certification website at www.ontariopesticide.com/index.cfm/home-page or call 1-888-620-9999 or 519-674-1575
- the Pesticide Industry Council website at www.hort-trades.com or call 1-800-265-5656 or email pic@hort-trades.com
- the Pesticide Industry Regulatory Council (PIRC) at www.oipma.ca

Exception for Golf Courses, Specialty Turf and Tree Care Specialists

For information about requirements under the *Pesticides Act* and Regulation 63/09, for golf courses and other excepted uses for turfgrass, including mandatory golf course IPM accreditation *Pesticides Act* go to www.ontario.ca and search for:

- Pesticides and Golf Courses
- Specialty Turf and Specified Sports Fields

For more information about requirements in the Pesticides Act and Regulation 63/09 for the exception regarding the use of pesticides to maintain the health of trees, go to www.ontario.ca and search for:

- Tree Care Specialists

For more information about pesticide regulations, certification and licensing, see:

- Inside front cover of this publication
- Pest Management Regulatory Agency (PMRA) website: www.healthcanada.gc.ca/pmra
- PMRA Pest Management Information Service: 1-800-267-6315 (from within Canada) or 1-613-736-3799 (from outside Canada)
- Ontario Ministry of the Environment and Climate Change (MOECC) website: www.ontario.ca/pesticides
- Regional MOECC Pesticides Specialist (See Appendix E. Ontario Ministry of Environment and Climate Change — Regional Contact Informationon page 99.)
- Ministry of Agriculture, Food and Rural Affairs (OMAFRA) website: www.ontario.ca/omafra
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) website: www.opep.ca
- Ontario Pesticide Training & Certification website: www.ontariopesticide.com/index.cfm/home-page
- Pesticide Industry Council website at www.hort-trades.com
- IPM Council of Canada website: www.ontarioipm.com or www.ipmcouncilcanada.org
- Pesticide Industry Regulatory Council (PIRC) at www.oipma.ca

Pesticide Application Information

When you decide to use a pesticide, choose the most appropriate formulation and application method for your situation. Use only properly calibrated sprayer equipment. Choose less toxic and less volatile alternatives when possible. Take all possible precautions to prevent the exposure of people and non-target organisms to the pesticide. Read the most current

pesticide label thoroughly before application. The label provides important information, such as:

- directions for use (e.g., rates of application, crops/sites it can be used on, target pests, crop rotation restrictions, total number of applications, droplet size/nozzle type, application equipment, timing, appropriate weather conditions)
- required personal protective equipment (PPE)
- hazard symbols and warnings
- restricted entry intervals
- buffer zones
- precautionary statements
- steps to be taken in case of an accident
- disposal

For more information on hazards, consult the Material Safety Data Sheet (MSDS) or contact the manufacturer.

For more information on pesticide application, see:

- OMAFRA Factsheet *Calibrating Airblast Sprayers*
- OMAFRA Factsheet *Adjusting, Maintaining and Cleaning Airblast Sprayers*
- OMAFRA Factsheet *How Weather Conditions Affect Spray Applications* (website only)
- OMAFRA Factsheet *Pesticide Drift from Ground Applications*
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) videos at www.opep.ca/index.cfm/learning-resources/videos/
- OMAFRA Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application,* Order No. BMP13
- OMAFRA Factsheet *Pesticide Contamination of Farm Water Supplies — Recommendations on Avoidance, Cleanup and Responsibilities*

Restricted Entry Intervals

Restricted Entry Interval (REI; also called Re-entry Period) is the period of time after a pesticide has been applied that agricultural workers or anyone else must not do **hand labour tasks** in treated areas. The REI allows the pesticide residues and vapours to dissipate to safe levels for work to be done.

Regardless of the REI, there is **no entry into the treated area for 12 hours** following the end of the application, unless you are a Certified Farmer or Licensed Commercial Applicator (exterminator) entering the treated area to perform short-term tasks, wearing the proper personal protective equipment and respirator.

An REI can range from 12 hours to several days. A pesticide label may state different REIs that are specific to a crop and post application task (e.g., scouting, harvesting). If the REI is not stated on a label for agricultural crops, use a 12 hour REI. For golf courses and residential turf applications, the spray solution must be dry before entry can occur.

Hand labour tasks involve substantial worker contact with treated surfaces such as plants, plant parts or soil. Examples of these activities include planting, harvesting, pruning, detasseling, thinning, weeding, scouting, topping, sucker removal, mowing, roguing, and packing produce into containers in the field or greenhouse. You can only do these tasks after the REI has passed. Hand labour generally does not include operating, moving or repairing irrigation or water equipment, except for hand-set irrigation.

A Certified Farmer or Licensed Commercial Applicator (i.e., a holder of the appropriate Exterminator License, such as an Agriculture Exterminator Licence or a Greenhouse/Interior Plant Exterminator Licence), may need to re-enter a treated area to do short-term tasks before the end of the REI. In these cases, the Certified Farmer or Licensed Commercial Applicator may re-enter 4 hours after the application wearing a NIOSH-approved respirator and any other protective clothing and the personal protective equipment stated on the label for mixing and loading. This Certified Farmer or Licensed Commercial Applicator (exterminator) must not be in the treated area during the REI for more than a total of 1 hour in any 24 hour period.

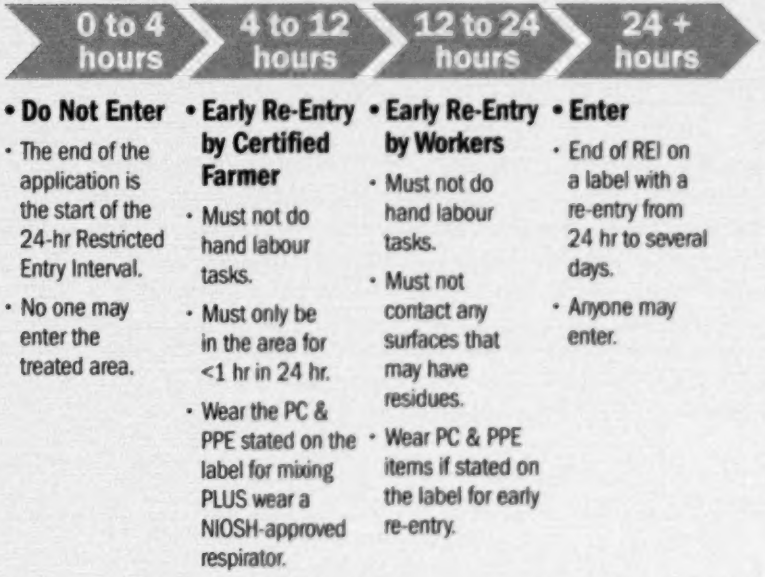

0 to 4 hours
4 to 12 hours
12 to 24 hours
24 + hours
• Do Not Enter
• The end of the application is the start of the 24-hr Restricted Entry Interval.
• No one may enter the treated area.
• Early Re-Entry by Certified Farmer
• Must not do hand labour tasks.
• Must only be in the area for <1 hr in 24 hr.
• Wear the PC & PPE stated on the label for mixing PLUS wear a NIOSH-approved respirator.
• Early Re-Entry by Workers
• Must not do hand labour tasks.
• Must not contact any surfaces that may have residues.
• Wear PC & PPE items if stated on the label for early re-entry.
• Enter
• End of REI on a label with a re-entry from 24 hr to several days.
• Anyone may enter.

Figure 1-1. Example of a 24 hour REI on a pesticide label.

Days to Harvest Intervals for Food Crops (Pre-harvest, Pre-grazing and Feeding Intervals)

These intervals state the minimum time that must pass between the last pesticide application and the harvesting of the crop or the grazing and cutting of the crop for livestock feed. If you harvest a crop before the pre-harvest interval (PHI) has passed, there may be pesticide residues in excess of the maximum residue limits (MRLs) set by PMRA.

"Up to the day of harvest" means the same as 0 days PHI; however, the REI may be more restrictive (e.g., a 12-hour restricted entry interval) and must be observed for harvesting that occurs on the day of pesticide application.

To avoid exceeding the maximum residue limits, always follow the directions on the label.

Buffer Zones

Buffer zones, or no-spray areas, are areas left untreated to protect an adjacent sensitive area, such as sensitive terrestrial and aquatic habitats. Generally, a buffer zone is the downwind distance separating the point of direct pesticide application from the nearest boundary of a sensitive habitat.

Leave a suitable buffer zone between the treatment area and adjacent sensitive area. Buffer zones may vary depending on the method of application (e.g., aerial, field boom, air blast). Check the pesticide labels for buffer zone requirements.

Sensitive terrestrial habitats include hedgerows, grasslands, shelterbelts, windbreaks, forested areas and woodlots.

Sensitive freshwater habitats include lakes, rivers, streams, creeks, reservoirs, marshes, wetlands and ponds.

Health Canada's PMRA has an online spray drift calculator that allows applicators to modify the buffer zones specified on the product label based on weather conditions, the category of the spray equipment and the droplet size. For more information, see the Buffer Zone Calculator at www.hc-sc.gc.ca/cps-spc/pest/agri-commerce/drift-derive/calculator-calculatrice-eng.php.

Setback Distances for Water Bodies

It is an offence under the federal *Fisheries Act* to introduce into water any material that may be harmful to fish or fish habitat. To protect these waters, applicators must determine a suitable setback distance between the area to be protected and the area where pesticide treatments are planned (if the setback distance is not specified on the pesticide label). The protected area includes the water body as well as adjacent riparian (riverbank) areas that contribute to fish food and habitat.

Protect the Environment

Protect Water Sources

According to the British Crop Protection Council (BCPC), 40–70% of surface water pesticide contamination comes from mixing and filling areas.

Where possible, load or mix pesticides on impermeable surfaces located safely away from watercourses or environmentally sensitive areas. Collect drainage and run-off and dispose of it safely (*Your Guide to Using Pesticides*, BCPC 2007).

Clean your spray equipment away from wells, ponds, streams and ditches. Apply the diluted rinse water (usually at a ratio of 10:1) to the treatment area (crop), but do not exceed the pesticide rate recommended on the label.

Do not make a direct connection between any water supply (e.g., public supply, wells, watercourse or pond) and a spray tank. Use an anti-backflow device or intermediate system to prevent back-siphoning that could contaminate the water supply.

Immediately contain and clean up any spills to prevent contamination to water sources.

Check the pesticide label for specific instructions on protection of water sources.

For more information on protecting water sources, see:

- OMAFRA Factsheet *Pesticide Contamination of Farm Water Supplies — Recommendations on Avoidance, Cleanup and Responsibilities*
- OMAFRA Factsheet *Groundwater — An Important Rural Resource: Protecting the Quality of Groundwater Supplies*
- OMAFRA Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application*, Order No. BMP13

Bee Poisoning

Honeybees, native bee species and other pollinating insects are important pollinators for many Ontario crops. Insecticides, some of which may negatively affect bees, require careful management to achieve both pollination and insect control. Growers and licensed commercial applicators can protect bees by following these suggestions:

- Time insecticide applications to minimize bee exposure (e.g., apply post bloom). Daytime treatments, when bees are foraging, are most hazardous. Insecticide applications in the evening are the safest, unless there is evidence of a strong temperature inversion. Under normal circumstances, spraying after 8 pm allows the spray to dry before the bees are exposed to it the next day. Early morning is the next best time, but spraying should be completed well before 7 am. While honeybees and most other pollinating insects do not usually forage at temperatures below 13°C, bumblebees do. If you plan to spray in the morning, contact beekeepers who have bees within 5 km of your crop and spray site. The beekeepers may then have the option of taking any possible protective action.
- Do not apply insecticides while fruit trees are in bloom. The *Bees Act* makes it an offence to do so in Ontario. Do not spray any flowering crop on which bees are foraging.
- To prevent drift toward nearby hives, do not apply insecticides on windy days or when there is evidence of a strong temperature inversion.
- Bees and other pollinators may be poisoned by visiting flowering weeds, trees and cover crops that have come into contact with an insecticide via spray drift or drift of insecticide-contaminated dust during planting. Avoid spray drift to flowering weeds that are adjacent to or within the target field. Where possible, mow down flowering cover crops or flowering weeds in and bordering target fields prior to spraying to help safeguard the bees. Control dandelions and other flowering weeds within fields before spraying it or planting seeds treated with an insecticide. Take measures to reduce movement of dust from insecticide seed treatments to flowering trees, weeds and water sources that are in or adjacent to the target field. See the *Field Crop News* blog at fieldcropnews.com for current information on ways to reduce dust movement.

- Systemic insecticides may also pose a high risk to bees and other insect pollinators. Bees can be exposed to insecticide residues in or on flowers, leaves, pollen, nectar and/or surface water. Do not apply insecticide or allow it to drift onto blooming crops or off-site habitat if bees are foraging in or adjacent to the treatment area.
- Beekeepers should remove honeybee colonies as soon as pollination is complete in the crop and before any insecticides are applied post bloom. If the colonies cannot be removed in time, beekeepers can place burlap or cloth soaked in water at the entrance of the hive to disrupt the flight of the bees for up to 12 hours and provide more time for spray to dry. To help prevent overheating of the hive during this time, keep an opening of 2.5 cm on each side of the hive entrance so bees can still get out and ventilate the hive. Also, the water on the burlap or cloth will help cool the colony.
- If there is a risk of honeybee poisoning, try to choose an insecticide that is not highly toxic to bees. When there is a choice, choose a product formulation that is less hazardous to bees.
- Always read the most current label for guidance.
- Before applying a pesticide or planting with insecticide-treated seed, advise local beekeepers so they can move colonies out of the danger area, if this is an option. Contact information for the local beekeepers' association in your area can be found on the Ontario Beekeepers' Association website at www.ontariobee.com/community/local-beekeepers-associations. Other ways to find your local beekeepers are to contact the Provincial Apiarist at 1-888-466-2372, ext. 63595 or see www.ontario.ca/crops and click "Apiculture" and then "Bee Inspectors" for a list of provincial bee inspectors who know the local beekeepers.

Manage Drift

Pesticide drift is the aerial movement and unintentional deposit of pesticide outside the target area. Drift results in wasted product and may compromise crop protection and also may adversely affect nearby sensitive environmental areas, crops and wildlife. The following strategies can help reduce the risk of pesticide drift:

- Do not spray when wind speeds are high or gusty. These conditions increase the potential for spray and vapour drift. Check pesticide labels for allowable wind speeds for spraying applications. However, not all labels provide this specific information.
- Constantly monitor wind conditions during spraying using a good-quality wind meter. Record the wind speed and direction. As wind conditions change, you may need to make adjustments to further reduce the drift potential, such as increasing water volume, minimizing nozzle-to-target distance, changing nozzle technology, changing fields because of surrounding influences or stopping spraying until conditions improve.
- Do not spray during periods of dead calm. Periods of dead calm may occur in early morning or late evening, at which time the temperature is usually cooler and the relative humidity is typically higher, which can result in the spray droplets remaining aloft, like fog. When the wind picks up, these spray droplets can move away from the target area, possibly causing injury to adjacent non-target areas. Off-target drift in calm conditions can occur hours after the spray event was completed.

Temperature inversions create problems for spray applicators because pesticide spray can:

- stay concentrated for long periods over the target
- move with the cool air over considerable distances when the breeze picks up
- move down slopes and concentrate in low-lying regions
- drift unpredictably as the inversion dissipates during the morning

Field air temperatures are often very different from local or regional forecasts, so the most reliable method of detecting inversion conditions is to measure temperatures at, and several metres above, the ground. Spray applicators can recognize a temperature inversion when:

- there is a big difference between the daytime and nighttime temperatures
- early evening and nighttime wind speeds are considerably less than during the day
- sounds seem to carry further
- odours seem more intense

- daytime cumulus clouds collapse toward evening
- overnight cloud cover is 25% or less
- mist, fog, dew or frost occur
- smoke or dust hangs in the air and/or moves laterally in a sheet.

Temperature inversions start to form 3 hours prior to sunset, become stronger as the sun sets and continue until sunrise when the surface warms and air mixing begins. **If you suspect there's an inversion, then don't spray. Often, warnings for the risk of inversions are stated right on the product label.**

- Use the sprayer output specified on the pesticide label.
- Use a nozzle that will produce the droplet size specified on the pesticide label or delivers droplets appropriate for the job. Nozzles that produce fine droplets are rarely, if ever, required.
- Where practical, use air induction/venturi nozzles, which significantly reduce drift compared to conventional nozzles.
- Check the height of the boom to the target or distance from airblast boom to the target. Minimize the distance as much as possible while still maintaining spray uniformity.
- Establish buffer zones for the protection of adjacent sensitive areas. Some pesticide labels will state buffer zone setbacks; follow these carefully.
- Use spray plume protection where practical or available (hoods, shrouds, screens or air curtains).
- Use drift-reducing adjuvants in the spray tank as directed on the label. Mechanical or hydraulic agitations have been shown to reduce the effectiveness of certain drift-reducing adjuvants. Be aware that certain combinations of anti-drift adjuvants and air-induction/venturi nozzles have been shown to increase the incidence of fine droplets that will drift.
- When possible, use non-volatile pesticide formulations or products.

For more information about spray drift, see:

- OMAFRA Factsheet *Pesticide Drift from Ground Applications*
- OMAFRA Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application,* Order No. BMP13
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) videos *How to Manage Spray Drift and Spray Drift Reduction Through Air Induction*, available at www.opep.ca/index.cfm/learning-resources/videos/chapter-18-drift-of-pesticides/

Pesticide Disposal

Empty Pesticide Containers Up to 23 L

Never re-use empty containers.

The Ontario Empty Pesticide Container Recycling Program, an industry-led program, is available free of charge to growers and commercial applicators. Through this program, you can return triple-rinsed or pressure-rinsed plastic pesticide containers up to 23 L to container collection depots located throughout the province. Remove the cap and booklet from the pesticide container before recycling. To locate the closest container collection depot, visit www.cleanfarms.ca, call your local dealer, or contact CleanFARMS at 416-622-4460 (toll-free at 877-622-4460) or info@cleanfarms.ca.

Please note that starting in 2013 this program now includes liquid fertilizer containers up to 23 L in size.

Empty Pesticide Containers Greater Than 23 L

Growers and commercial applicators can return pesticide containers that are greater than 23 L in size. Contact your local dealer for details on disposal of these containers, or contact CleanFARMS at 416-622-4460 (toll-free at 877-622-4460) or info@cleanfarms.ca.

Surplus Spray Mix

The best approach is to plan the spray job accurately to avoid creating a surplus.

When this is unavoidable, dispose of excess spray mix by spraying it on other crops that require an application of this pesticide. Before spraying, check the label to make sure the pesticide is registered for use on that other crop.

If you cannot find another allowable crop to spray, then dilute the remaining spray mix by adding 10 parts of water for each 1 part of spray mix. The diluted solution can be safely applied to the original treated area as long as you do not exceed the pesticide rate recommended on the label. Be sure to check the label for any restrictions about crop rotation, days to harvest or disposal of surplus spray mix.

Never re-spray the treated field with undiluted spray mix. Spraying an area twice at the same pesticide rate will double the labeled pesticide rate. This may cause illegal pesticide residues in the harvested crop or harmful residues in the soil that can cause crop damage.

Surplus Pesticide Disposal

Be sure to safely dispose of pesticides that you do not need or cannot use. Options for proper disposal include:

- Contact the supplier. It is sometimes possible to return unused pesticide if it is still in its original, unopened container.
- Hire a waste hauler who is licensed under Part V of the *Environmental Protection Act* to carry hazardous wastes. Look in the Yellow Pages of your telephone directory under Liquid Waste Removal.
- CleanFARMS operates a free Obsolete Pesticide Collection Program throughout the province every three years. To locate the closest collection point and date, visit the CleanFARMS website (www.cleanfarms.ca), contact CleanFARMS at 416-622-4460 (toll free at 877-622-4460) or info@cleanfarms.ca or contact your local dealer for program details.
- Contact your municipality to see if any waste collection days are scheduled and verify whether quantities of agricultural pesticides will be accepted.

Storing Pesticides

Ontario's *Pesticides Act* and Regulation 63/09 provide details on storage requirements for pesticide storage facilities. As shown in Table 1–1, the storage requirements that must be followed are dependent on which classes of pesticides you store.

Table 1–1. Requirements for Pesticide Storage Facilities

Storage requirements	Pesticide Classes			
	Class 2	Class 3	Class 4, 5 & 7	Class 6
No contact with food or drink	YES	YES	YES	YES
Not an impairment to health and safety	YES	YES	YES	NO
Clean and orderly	YES	YES	YES	NO
Warning sign G posted*	YES	YES	YES	NO
Emergency telephone numbers posted**	YES	YES	YES	NO
Vented to outside	YES	YES	NO	NO
Limited access (locked)	YES	YES	NO	NO
No floor drain	YES	YES	NO	NO
Respiratory protection and protective clothing kept readily available	YES	YES	NO	NO
Area used primarily for pesticides	YES	NO	NO	NO

Note: Sufficient precautions are needed in your storage area to prevent the pesticide from entering the natural environment. Ensure your floor drain does not enter the natural environment.

* Refer to MOECC's website www.ontario.ca/pesticides for requirements for warning sign G. These signs can be purchased from your pesticide dealer/vendor.

** Emergency contact numbers must include telephone numbers for the local fire department, hospital and poison control centre. The number for the MOECC Spills Action Centre (1-800-268-6060) should also be readily available.

For more information about storing pesticides, see:

- OMAFRA Factsheet *Farm Pesticide Storage Facility*
- OMAFRA Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application,* Order No. BMP13
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) *Grower Pesticide Safety Course Manual,* available at www.opep.ca. Select "Learning."

Pesticide Spills

If a pesticide spill causes, or is likely to cause, an adverse effect that is greater than that which would result from the proper use of the pesticide, you must notify the Ministry of the Environment Spills Action Centre at 1-800-268-6060 (24 hours a day, 7 days a week) and your municipality.

A spill is defined as a discharge of pollutant that is abnormal in quality or quantity, from or out of a structure, vehicle or other container into the environment. An incident such as an overturned pesticide sprayer that results in the loss of the spray solution to the environment is an example of a spill. A pesticide container that ruptures and leaks its contents is another example of a spill. The discharge or spraying of a pesticide in an unapproved area is also considered a spill.

Before you begin to clean up a spill of any nature, remember to protect yourself against pesticide exposure. Wear the proper protective clothing and personal protective equipment. If the spill occurs inside an enclosed area (e.g., a pesticide storage area or a vehicle during transport), ventilate the area first. Once you have protected yourself and removed other persons or animals from the spill site, take additional measures to stop the spill at the source and prevent it from spreading and/or contaminating watercourses. Specific precautions, emergency contact information and first aid procedures may be found on the label.

For minor spills, it may be possible to rectify the problem:

- **For a liquid spill** — Cover the spill with a thick layer of absorbent material such as kitty litter, vermiculite or dry soil. Sweep or shovel the material into a waste drum and dispose of the contents as you would a hazardous waste.
- **For a dust, granular or powder spill** — Sweep or shovel the material into a waste drum and dispose of the contents as you would a hazardous waste.

For major spills, it is essential to stop the spill from spreading.

The cleanup guidelines above may not be appropriate for all spill situations. Once you have contained the spill, follow directions from the manufacturer and regulatory authorities on cleaning the contaminated area.

For information on preventing spills, see:

- OMAFRA Factsheet *Ways to Avoid Pesticide Spills*
- OMAFRA Agriculture and Agri-Food Canada booklet *Best Management Practices — Pesticide Storage, Handling and Application,* Order No. BMP13
- Ontario Pesticide Education Program (University of Guelph, Ridgetown Campus) Grower Pesticide Safety Course Manual, available at www.opep.ca. Select "Learning."

For pesticide poisonings and pesticide injuries, call:
Poison Information Centre:
1-800-268-9017
(TTY) 1-877-750-2233
For more information, see *Emergency and First Aid Procedures for Pesticide Poisoning* on the inside back cover.

2. Safe Use of Pesticides

For further information on the safe use of pesticides, refer to the *Grower Pesticide Safety Course Manual* found on the Ontario Pesticide Education Program's website at www.opep.ca.

Human Health

Risks of Pesticide Use

Each time a pesticide is handled, there is some risk. The amount of risk depends on two things: the toxicity of that pesticide and the degree of exposure to it.

Toxicity is a measure of how harmful or poisonous the pesticide is. There are two types of toxicity: acute and chronic.

- **Acute toxicity** is the toxic response that results from a single exposure to the pesticide. The symbols and words on the front panel of a pesticide label give information about the acute toxicity (see Table 2–1, *Label Hazard Symbols and Signal Words*, on page 12).

Lethal dose 50% (LD_{50}) is a measure of acute toxicity. It is the dose (in mg of product per kg of body weight) that will kill 50% of test animals (usually female rats) within a stated period of time (24 hours to 7 days). This is commonly measured as the acute oral LD_{50}, which refers to the ingestion of the chemical through the mouth or nose. Dermal LD_{50} figures, which refer to penetration of the chemical through the skin, are also available. The oral LD_{50} of a pesticide is listed in Table 3–1, *Insecticide and Miticide Toxicity*, and Table 3–2, *Fungicide Toxicity*.

The lower the LD_{50} figure, the more toxic the product is to humans.

Examples of products with a high acute toxicity (low LD_{50}) include:

Common (Active) Name	Trade Name
dichlorvos	DDVP
endosulfan	Thionex

- **Chronic toxicity** is the toxic response that results from repeated exposure to small doses of a pesticide over a longer period of time. These toxic effects may not appear for months or years after exposure to the pesticide. The symbols on the label do not give information about the chronic toxicity of the product. Use protective clothing and equipment to help reduce exposure and risk of chronic effects.
- **Exposure** refers to contact with the pesticide. Workers can be exposed to the pesticide in three ways:
- **Dermal exposure** occurs through the skin or eyes. The amount and rate of pesticide that may be absorbed depends on several things, including:
  - Skin condition at time of exposure: If the skin is moist, or if a rash, broken skin or scratches are present, pesticides will be absorbed more easily.
  - Part of the body that is exposed: Eyes, genital area, scalp and ear canals absorb pesticides at a higher rate than hands or arms. Eyes are particularly vulnerable because the tissues are very absorbent.
- **Respiratory exposure (inhalation)** occurs when small spray particles, dust, gases or vapours are inhaled.
- **Oral exposure** occurs when a pesticide enters the mouth or is swallowed.

Cholinesterase Blood Tests

Organophosphorus and carbamate pesticides can affect the human nervous system. These pesticides can reduce the levels of the enzyme acetyl cholinesterase in the serum and red blood cells. The body uses this enzyme to transmit messages through the nervous system. If cholinesterase levels fall, individuals experience symptoms such as trembling, twitching, blurred vision, salivation, sweating, breathing difficulties and frequent bowel movements and urination.

People who use any organophosphorus or carbamate pesticides on a routine basis should have regular cholinesterase blood tests. A family doctor can arrange these tests, which are covered by the Ontario Health Insurance Plan (OHIP). Workers should have their first test before beginning to handle these pesticides to determine their normal (baseline) cholinesterase level.

During the spray season, workers who spray organophosphorus or carbamate insecticides regularly for several weeks should have a cholinesterase blood test every 7 to 10 days. If the worker's cholinesterase level drops to less than half of the baseline level or the worker is showing signs of pesticide poisoning, he/she must avoid exposure to these pesticides until cholinesterase levels return to normal.

Examples of organophosphorus insecticides

Common (Active) Name	Trade Name
dichlorvos	DDVP
malathion	Malathion
naled	Dibrom

Read and Follow Pesticide Label Information

Know the Hazard Symbols and Signal Words

Four important symbols and words show the potential hazards of pesticides.

Table 2–1. Label Hazard Symbols and Signal Words

Hazard Symbol	Signal Word
	Poison
	Corrosive
	Flammable
	Explosive

The hazard symbol always appears inside one of the shapes shown below. The shape and its signal word together indicate the degree of hazard of the pesticide. The greater the number of sides of the shape, the more hazardous the product.

Table 2–2. Degree of Hazard, Warning Symbol and Signal Word

Degree of Hazard	Warning Symbol	Signal Word
Triangular shape (3 sides) means low hazard		Caution
Diamond shape (4 sides) means moderate hazard		Warning
Octagonal shape (8 sides) means high hazard		Danger

Learn these symbols and words — they could save your life!

Check the label for special warnings about eye hazards and skin hazards.

First Aid

If an accident occurs:

1. Rescuers should always protect themselves from injury. Protective clothing and equipment should always be worn before entering a contaminated area or handling a contaminated victim.
2. Check to see if the victim is conscious. If the victim is not conscious, call 911 right away.

Symptoms of Pesticide Poisoning

Mild Symptoms

Headache, fatigue (tired feeling), loss of appetite, dizziness, weakness, nervousness, nausea, perspiration, diarrhoea, loss of weight, thirst, moodiness, irritation of the skin, eyes, nose or throat

Moderate Symptoms

Nausea, trembling, loss of muscular co-ordination, excessive saliva, blurred vision, constricted throat or chest, laboured breathing, flushed or yellow skin, abdominal cramps, vomiting, diarrhoea, mental confusion, perspiration, rapid pulse, cough

Severe Symptoms

Vomiting, loss of reflexes, inability to breathe or increased breathing rate, muscle twitching, tiny pupils, convulsions, unconsciousness, thirst, fever

(Source: *Grower Pesticide Safety Course Manual,* University of Guelph Ridgetown Campus. Available online at www.opep.ca.)

If symptoms occur during or shortly after handling a pesticide, go to a hospital. Take the pesticide label, Material Data Safety Sheet (MSDS) or pesticide container. Do not transport the container in the passenger compartment. See the Emergency First Aid Procedures for Pesticide Poisoning on the inside back cover.

3. Check to see if the victim is breathing.

   If the victim is not breathing, call 911 and then:

   - Straighten the victim's airway and check for breathing
   - If the victim does not begin to breathe, perform artificial respiration until the victim begins to breathe independently.

- Avoid becoming contaminated, especially if the victim has pesticide or vomit around the face or mouth. Use a face shield airway with a one-way valve. Do not breathe the exhaled air from the victim.
- If the victim's pulse disappears, perform CPR if qualified to do so.

If the victim is breathing, but unconscious, call 911 and then:

- Place the victim in the recovery position (on the side with the head turned slightly down). If the victim vomits, try to keep the airway clear.

4. Stop the exposure to the pesticide. Move the victim away from the contaminated area. Remove all contaminated clothing from the victim. Use soap and water to wash any skin exposed to the pesticide.
5. Check the four basic facts:
   - What? Identify the pesticide. Look for the label, container or leftover pesticide.
   - How much? How much product was the victim exposed to?
   - Where? Did the pesticide enter the body through the mouth, skin, eyes or lungs?
   - When? How much time has passed since the victim was exposed to the pesticide, and how long was the exposure? Were the symptoms immediate, or did the poisoning occur as a result of using the pesticide over a longer period of time?

Don't waste time.
If you can't answer these questions quickly, be ready to tell emergency personnel whatever you can.

6. Call an ambulance or the poison information centre.
7. Start the first aid treatment appropriate for the contaminant and route of entry. First aid instructions can be found on most pesticide labels.
8. Make sure the patient gets medical attention. First aid is not a substitute for professional medical help.

General Precautions When Using Pesticides

Always read the label:

- before buying a pesticide
- before using a pesticide
- before storing or disposing of a pesticide

Always keep records of pesticide use.

Learn about the health hazards and toxic properties of the pesticide being used. Consult the product label, Material Safety Data Sheets (MSDS) or manufacturer for this information. Check the company's website for MSDS information.

Protection When Using Pesticides

Tell someone where the work is taking place, what pesticides are being handled and how long the job is expected to take.

Post emergency numbers, including the numbers for the Poison Information Centre and Spills Action Centre, near all telephones.

Keep a list of the names and the *Pest Control Products (PCP) Act* Registration Numbers of all the pesticides handled. It's a good idea to keep a file of the pesticide label booklets for all the products used. Ensure that co-workers and family members know where to find this list or file in case of an accident.

Have plenty of clean water, soap and paper towels — and an extra set of gloves and coveralls — nearby at all times in case a pesticide contaminates clothing or skin.

Wear the correct protective clothing and equipment, and be sure that all items are clean and in good repair before wearing or using them.

Never smoke, chew tobacco, eat or drink when handling pesticides. Never carry tobacco or food in clothes; never leave tobacco, food or beverages in areas where pesticides are handled or stored.

Shower, or at a minimum, change clothes and wash hands and face before eating, drinking or smoking.

Wash hands before using the toilet, as well as after. The skin in the groin area absorbs pesticides very easily.

Protective Clothing and Equipment

Choose and wear the appropriate protective clothing and equipment. Make sure protective clothing and equipment fit properly and are clean, in good repair and in working condition. The protective clothing and equipment workers should wear depends on:

- **The pesticide being used** — read the precautions section of the label to know what is required.
- **The job being done** — for example, use more protection when handling concentrated pesticide or when mixing and loading a sprayer.
- **The type of application** — enclosed space or air-blast sprayer applications made with open tractors require more equipment.

All persons who work with pesticides need their own set of protective clothing and equipment. Consult the product label to find out what protective clothing is required.

For all pesticides, always wear:

- A water-repellent hat, such as a hard hat or waterproof rain hat
  - Sometimes the entire head and neck must be protected: for example, if applying pesticides in a greenhouse, applying dusty formulations or using an air-blast sprayer. In these situations, wear a hood or hat that protects the ear canals. Do not wear baseball-style or other cloth hats, which absorb pesticides and are not safe.
- Long pants and a long-sleeved shirt or coveralls
  - Coveralls can be reusable or disposable. Reusable coveralls are normally cotton or polyester and should be tightly woven. Disposable coveralls should be designated for pesticide use.
  - Water-resistant coveralls are preferred because cotton, denim and cotton/polyester pants cling to the skin if they get wet, which increases the risk of dermal exposure.
- Chemical-resistant gloves (unlined)
  - Use neoprene, nitrile or PVC gloves, unless the label states otherwise. Do not wear rubber gloves, because many pesticides can break down the rubber material. Fold up the cuffs of the gloves and wear the gloves tucked under the shirt or jacket sleeves.
- Chemical-resistant boots (unlined)
  - Wear pant legs over boots to prevent pesticide from running down inside the boots.

Read the label. It will describe what extra protective clothing and equipment to wear.

For some pesticides, workers should also wear:

- Goggles
  - Use safety goggles with indirect vents so that splashes do not enter the eye. Regular eyeglasses do not provide complete protection. Never wear contact lenses when handling pesticides.
- Face shield
- Chemical-resistant apron
- Respirator
  - A respirator is a unit that covers the mouth and nose to prevent spray droplets, small particles and vapours from entering the lungs. A dust mask is not a substitute for a pesticide respirator. Respirators and replacement cartridges should be NIOSH/MSHA approved. Use cartridges and pre-filters that protect against organic vapours. For more information about respirators, see the *Grower Pesticide Safety Course Manual*, Ridgetown College, University of Guelph.

When Working in Enclosed Areas

Canister Respirators

Canister gas masks are effective for protection against certain harmful gases, vapours and particulate matter. They are generally suitable for ventilated areas where conditions don't change rapidly. They should never be used in confined spaces where oxygen deficiency or high gas concentrations may occur.

Self-Contained Breathing Apparatus

Air-purifying devices do not work in confined spaces where gas concentrations are unusually high. The lack of oxygen can prove fatal. Under these conditions, use an air supply provided by a self-contained breathing apparatus (e.g. Scott Air Pack).

Substances that produce hydrogen cyanide, methyl bromide, chloropicrin or phosphine can produce high gas concentrations and reduce oxygen levels. A similar situation is caused by the use of smoke generators and foggers that use highly toxic pesticides and certain volatile sprays.

Other Protective Clothing

Wear other protective clothing in keeping with the requirements listed on the pesticide label.

Working Conditions

Always check and follow the label for appropriate safety equipment requirements. Use the recommendations below as a guide only.

- Use canister respirators when the surrounding air contains low concentrations of toxic gases, vapours or particulate matter derived from soil-drench, granular, dust or foliar-spray applications. Pesticides applied in this manner usually have moderate to low toxicity.
- Use a self-contained breathing apparatus (e.g. Scott Air Pack) when applying highly toxic pesticides. Pesticides can produce high concentrations of toxic gases, vapours or particulate matter, as well as reduce oxygen levels, especially in an enclosed space (e.g. when fumigating grain).
- Read the product label for recommendations and legal requirements. A list of safety supply companies can be found in Table 2–3, *Ontario Suppliers of Protective Clothing and Equipment*, below.

Safety Equipment Suppliers

Read the label for safety equipment recommendations and requirements. Protective clothing and equipment can be purchased from the suppliers listed in Table 2–3.

Table 2–3. Ontario Suppliers of Protective Clothing and Equipment

3-M Canada Inc.	Occupational Health and Environmental Safety P.O. Box 5757 London, ON N6A 4T1 www.3m.ca	Tel: 519-451-2500 Toll-free: 1-800-364-3577 Fax: 1-800-603-7758 Orders: 809-263-3489 OHS: 519-452-4600
Acklands Grainger	90 West Beaver Creek Road Richmond Hill, ON L4B 1E7 www.acklandsgrainger.com	Tel: 905-940-5535 Fax: 905-940-5537 Email: contact@agi.ca
Aearo Canada	6889 Rexwood Road Mississauga, ON L4V 1R2 www.aearo.com	Tel: 905-795-0700 Toll-free: 1-800-387-4304 Fax: 905-564-5250
DuPont Personal Protection	7070 Mississauga Road Mississauga, ON L5M 2H3 personalprotection.dupont.ca www.dupont.ca	Tel: 519-753-9306 Toll-free: 1-800-387-9326 Fax: 519-752-2161
HAMISCO	3392 Wonderland Road London, ON N6L 1A8 www.hamisco.com	Tel: 519-652-9800 Toll-free: 1-800-668-9800 Fax: 519-652-9661
Huron Tractor	39995 Harvest Road Exeter, ON N0M 1S3 www.hurontractor.com	Tel: 519-235-1115 Fax: 519-235-1939

International Safety	355 Harry Walker Parkway North, Units 9 and 10 Newmarket, ON L3Y 7B3 www.internationalsafety.com	Tel: 905-898-6906 Toll-free: 1-877-342-5477 Fax: 905-898-1597
Levitt-Safety (Eastern) Limited	2872 Bristol Circle Oakville, ON L6H 5T5 www.levitt-safety.com	Tel: 905-829-3299 Toll-free: 1-888-453-8488 Fax: 905-829-2919
Mitt & Robe Co.	751 Norfolk Street North Simcoe, ON N3Y 3R6 www.mittrobe.ca	Tel: 519-428-4050 Toll-free: 1-877-893-6565 Fax: 519-428-5142
MSA Canada Inc.	5535 Eglinton Avenue. West Unit 222 Toronto, ON M9C 5K5 www.msanet.com	Tel: 416-620-4225 Toll-free: 1-800-267-0672 Fax: 416-620-9697
Plant Products - A Division of MGS Horticultural Inc	50 Hazelton St. Leamington, ON N8H 3W1 www.plantproducts.com	Tel: 519-326-9037 Fax: 519-326-5861 Email: info@plantproducts.com
Safety Express	4190 Sladeview Crescent Units 1 and 2 Mississauga, ON L5L 0A1 www.safetyexpress.com	Tel: 905-608-0111 Toll-free: 1-800-465-3898 Fax: 905-608-0091 Email: info@safetyexpress.com
The St. George Company (Suppliers of Kasco Helmets)	P.O. Box 430 20 Consolidated Drive Paris, ON N3L 3T5 www.thestgeorgeco.com	Tel: 519-442-2046 Toll-free: 1-800-461-4299 Fax: 519-442-7191 Email: sales@thestgeorgeco.com
Sun Parlour Greenhouse Growers Cooperative	230 Essex Road 31 Leamington, ON N8H 3W2 www.sunparlourgrower.com	Tel: 519-326-8681 Fax: 519-326-3413

Care of Protective Clothing and Equipment

After completing the spray operation, clean all protective clothing and equipment.

Never let children, pets or livestock come in contact with contaminated clothing or equipment. Also ensure that they cannot come into contact with the puddles of water that result when cleaning equipment.

Wash gloves with soap and water and then leave them on while removing other protective clothing and equipment.

Always remove protective clothing and equipment outdoors. If a granular pesticide was used, shake the clothing outdoors in a safe place. Be sure to empty pockets and cuffs.

Dispose of clothing that has been contaminated by spills of highly toxic or concentrated pesticide. Place contaminated clothing in a plastic bag and take it to a landfill site.

Continue to wear gloves while washing protective equipment. It is best to wash equipment outdoors. If the work area does not have a cleanup area outside, designate specific buckets just for equipment cleanup. Mark them and keep them in a designated place. Wash the inside and outside of goggles, hats, boots and any water-repellent clothing in warm soapy water, then rinse them well and let them air-dry.

Respirators

Remove the cartridges and pre-filters from the respirator.

Discard cartridges, canisters and filter pads at the interval set by the manufacturer or earlier if breathing becomes difficult or a pesticide taste or odour is noticed.

Record the date the cartridge is first used.

Remove cartridges and filter pads from the face piece and store them in clean, sealed plastic bags.

Wash the face piece in warm soapy water, rinse it thoroughly and dry it in a well-ventilated area. Air-drying prevents damage to the inlet and outlet valves.

Never use alcohol or other solvents for cleaning because they will damage the rubber and plastic.

Rubber, Vinyl or Plastic Boots and Gloves

To avoid contact with pesticides, wash the outside of boots and gloves with detergent and water before taking them off.

After removing boots and gloves, wash them inside and out with detergent and water, rinse them thoroughly and dry them in a well-ventilated area.

How to Wash Clothes Used for Spraying

Never mix spray clothing with household laundry. All clothing used for spraying must be stored and washed separately from other clothing. Wash spray clothing after each use. Remember to use chemical-resistant gloves to handle pesticide-contaminated clothing.

Pre-soak clothing before washing. Use one of three methods:

- hose off garments outdoors
- soak them in a separate tub or pail
- use the pre-wash cycle in an automatic washer

Use hot water, a heavy-duty detergent and the highest water level and the longest cycle the washing machine offers. Follow the instructions that came with the machine for washing heavily soiled clothing.

Wash clothing twice.

After washing it, hang it outside (preferably in bright sunlight) until it is completely dry. Do not use a clothes dryer.

Clean the washing machine. Run the washing machine through one complete cycle using only detergent and hot water (no clothing). After laundering, place clean clothing in a plastic bag and keep them it separate from other clothing.

Personal Hygiene

Always wash hands before eating, drinking or smoking.

When finished for the day, take a bath or shower as soon as possible. The longer a pesticide remains on the skin, the greater the risk that it will be absorbed into the body.

Wash hair and scrub under fingernails. Shower with a lot of soap and water.

Always change into clean clothes.

Wear clean work clothes every day. A small spill on the previous day's clothes may seem unimportant, but wearing the same clothing again without washing it prolongs exposure and increases risk.

3. Pesticide Toxicity and Activity

The LD_{50} of various pesticides are listed in Table 3–1, *Insecticide and Miticide Toxicity* and Table 3–2, *Fungicide Toxicity*. LD_{50} is a measure of relative toxicity. It is the amount of product in milligrams used per kilogram of test animal (usually female rats) that kills 50% of the test animals. This is commonly measured as the acute oral LD_{50}, which refers to the toxicity of the chemical when it is ingested through the mouth or nose. Dermal LD_{50} figures are also available. These refer to the toxicity of the chemical when it enters the body through the skin. The lower the LD_{50} figure, the more toxic the product is to humans.

Note: Many pesticides with low acute toxicity cause long-term effects in laboratory animals. Users are therefore warned that even pesticides with high LD_{50} values could be detrimental to human health. Reduce exposure to all pesticides to a minimum by wearing protective clothing, including latex gloves, goggles and long-sleeved shirts. See Chapter 2 for more details.

Read every product label to ensure that it is used properly and safely.

Table 3–1. Insecticide and Miticide Toxicity

Common Name or Active Ingredient	Trade Name	Oral LD50 (mg product/ kg body weight)*
Abamectin	Avid 1.9 % EC	300
Acequinocyl	Shuttle 5 SC	>5,000
Acetamiprid	Tristar 70 WSP	1,064
Bacillus thuringiensis	BioProtec DiPel Foray Thuricide VectoBac	>5,000
Beauveria bassiana	Botanigard ES Botanigard WP	>5,000
Bifenazate	Floramite SC	>5,000
Chlorantraniliprole	Coragen SC	>5,000
Chlorfenapyr	Pylon	560-567
Citric acid, lactic acid	Cyclone	Citric acid: >3,000 Lactic acid: >4,000
Cyromazine	Citation 75 WP	>4,460
Diazinon	Diazinon 500 EC	1,600
Dichlorvos	DDVP 20% EC	56
Endosulfan	Thionex 50 W	41
	Thionex EC	45
Fenbutatin oxide	Vendex 50 WP	>5,000
Flonicamid	Beleaf 50 SG	>2,000
Fludioxonil + cyprodinil	Switch 62.5 WG	>5,000
Garlic	Influence	>5,000
Hydrogen peroxide	Storox	330
Imidacloprid	Intercept 60 WP	1,858
Lambda-cyhalothrin	Matador 120 EC	93
Malathion	Malathion 25 W	1,375
Metarhizium anisopliae Strain F52	Met52 EC	Not available
Naled	Dibrom	235
Penthiopyrad	Fontelis	>5,000
Permethrin	Ambush 50 EC	2,280
	Pounce 384 EC	1,030
Pymetrozine	Endeavor 50 WG	>5,000
Pyridaben	Dyno-Mite 75 WP	1,930

Table 3–1. Insecticide and Miticide Toxicity *continued*

Common Name or Active Ingredient	Trade Name	Oral LD50 (mg product/ kg body weight)*
Pyriproxyfen	Distance	>3,773
Spinosad	Entrust 80 W Success 480 SC	>5,000
Spiromesifen	Forbid 240 SC	>2,000
Spirotetramat	Kontos	>2,000
Tebufenozide	Confirm 240 F	>5,000
Thiamethoxam	Actara	>5,000
Tridecenyl acetate	3M Sprayable Pheromone for Mating Disruption of Tomato Pinworm	>5,000

*Figures obtained from Material Safety Data Sheets for each individual product.

Table 3–2. Fungicide Toxicity

Common Name or Active Ingredient	Trade Name	Oral LD50 (mg product/ kg body weight)*
Bacillus subtilis	Cease Rhapsody	>5,000
Bacillus subtilis strain MBI 600	Biotak	No toxicity reported
Bacillus subtilis var. *amyloliquefaciens* Strain FZB24	Taegro	Very low acute oral toxicity
Bacteriophage of *Clavibacter michiganensis* subsp. *michiganensis*	AgriPhage-CMM	No toxicity reported
Boscalid + Pyraclostrobin	Pristine	>1,490
Captan	Maestro Supra Captan	>5,000
Copper hydroxide	Kocide 3000	1,847
Copper oxychloride	Fixed Copper	1,600
Cyprodinil + Fludioxinil	Switch 62.5 (cyprodinil + fludioxinil)	>5,000
Dicloran	Botran 75 W	>4,640
Fenhexamid	Decree	>2,000
Gliocladium catenulatum	Prestop	>2,000
Hydrogen peroxide	Storox	330
Iprodione	Rovral 50 WP	>2,000
Kasugamycin	Kasumin 2L	>5,000
Mancozeb	Manzate Pro-Stick	>5,000
Mandipropamid	Revus	>5,000
Metalaxyl-M	Ridomil Gold	1,172
Myclobutanil	Nova 40 W	3,129
Penthiopyrad	Fontelis	>5,000
Potassium bicarbonate	MilStop	2,700
Propamocarb hydrochloride	Previcur N	2,000
Pyrimethanil	Scala	>5,000
Reynoutria sachalinensis (Extract)	Regalia Maxx	>5,000
Streptomyces griseoviridis	Mycostop	>5,000
Streptomyces lydicus	Actinovate	No toxicity reported
Sulphur	Microscopic Sulphur Agrotek Ascend Vaporized Sulphur	>5,000
Trichoderma harzianum	RootShield	Active ingredient is practically non-toxic, non-allergenic and non-pathogenic to mammals

*Figures obtained from Material Safety Data Sheets for each individual product.

Pesticide Injury to Vegetable Crops

Although greenhouse pesticides have been selected and formulated to avoid plant injury, damage can still occur under some conditions. Consider these general rules before applying pesticides:

- No product is safe on all plants under all conditions, although wettable powders are generally less injurious than liquid formulations.
- Weather conditions at the time of application are important. Pesticides are more likely to harm plants when applied during bright, sunny weather than if applied during dull, overcast conditions.
- Well-watered, unstressed plants are less likely to be damaged by pesticides.
- Low-volume applications are generally less likely to cause plant injury than high-volume applications.
- Excessive spray pressure may damage leaf tissue.

4. Tomatoes

Products registered for insect and mite pests of tomato are listed in Table 4–1, *Products Registered for Tomato Insect and Mite Pests.* Products registered for tomato diseases are listed in Table 4–2, *Products Registered for Tomato Diseases.*

Table 4–1. Products Registered for Insect and Mite Pests of Tomato

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Alfalfa looper *(Autographa californica)*	Pylon	chlorfenapyr	30 mL/100 L	12	0	A maximum of 1 application per crop cycle is allowed. Do not apply as an ultra-low volume spray, nor through any type of irrigation system. Do not use on tomato varieties with a diameter of less than 2.5 cm when mature. Pylon is toxic to bees and other beneficial insects.
Aphids	BotaniGard WP	*Beauveria bassiana*	250–500 g/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months or at 35°C for no more than 1 month.
	DDVP 20% EC	dichlorvos	6 mL/L	24	7	Crop damage can occur particularly under hot, humid conditions. Thoroughly ventilate greenhouse before re-entering on the day following treatment.
	Dibrom	naled	10 mL/100 m^3	48	2	Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry.

Table 4–1. Products Registered for Tomato Insect and Mite Pests *continued*

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Aphids *Continued*	Endeavor 50 WG	pymetrozine	Apply 100–200 g/ ha in a minimum of 1,000 L/ha.	12	3	Do not exceed two applications per crop cycle. Do not apply more than three applications per greenhouse per year in greenhouses with multiple crop cycles. Do not re-apply for at least 7 days. On hard-to-wet plants add a nonionic or organosilicone-based surfactant to improve coverage.
	Insecticidal Soap	potassium salts of fatty acids	2 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage to flowers under high-temperature conditions.
	Intercept 60 WP	imidacloprid	16 g/60 L/1,000 mature plants	–	1	Do not apply more than once per season. Repellency of bumblebee pollinators and negative effects on some beneficials (e.g. *Orius* sp.) can occur.
	Kontos	spirotetramat	30-42 mL/100 L Maximum rate per single application is 300 mL/ha	12	3	Use the higher concentration for higher pest infestation levels. Interval between applications is at least 7-14 days. The maximum number of applications per cropping cycle is 3. A maximum of 900 mL of product/ha is allowed per crop cycle. Do not exceed a spray volume of 712 L/ha (42 ml concentration) to 1,000 L/ha (30 ml concentration). Avoid application during flowering. Residues in/on pollen and nectar may harm bee brood, but the product is not acutely toxic to adult bees. The product is toxic to certain beneficials.
Banana moth *(Opogona sacchari)*	Bioprotec 3P Dry Flowable Biological Insecticide	*Bacillus thuringiensis* subsp. kurstaki	0.8 kg/1,000 L	–	0	Foliar application. Make application just prior to egg hatch. Apply the product such that it flows along the stem, coating it well. Thorough coverage of foliage and stems is necessary (minimum of 300 L of water per hectare). Re-apply at 7-day intervals, as required by monitoring.
Cabbage loopers	Bioprotec 3P Dry Flowable Biological Insecticide	*Bacillus thuringiensis* subsp. *kurstaki*	0.92 kg/1,000 L	–	0	Apply to young larvae at first signs of infestation. Repeat applications as necessary to maintain control of young larvae. The timing and number of applications will depend on foliage development and larval activity, including egg hatch, stage of larval development and population pressure.

Cabbage loopers *Continued*	Bioprotec CAF Aqueous Biological Insecticide	*Bacillus thuringiensis* subsp. *kurstaki*	1.8 L/1,000 L	–	0	Apply to young larvae at first signs of infestation. Repeat applications as necessary to maintain control of young larvae. The timing and number of applications will depend on foliage development and larval activity, including egg hatch, stage of larval development and population pressure.
	Confirm 240 F	tebufenozide	0.6 L/ha	12	2	Use application interval of at least 10 days. Do not exceed four applications/year.
	Coragen	chlorantraniliprole	125 mL/1,000 L	12	1	Begin applications when treatment thresholds have been reached. Thorough coverage is required to obtain optimum control. Repeat applications if monitoring indicates it is necessary. Do not make more than 3 applications per crop cycle.
	DiPel 2X DF	*Bacillus thuringiensis* subsp. *kurstaki*	75–150 g/ 250 L/4,000 m^2	–	0	Apply to upper and lower portions of the leaves to run-off. Repeat applications will be necessary if a new hatch occurs.
	DiPel WP	*Bacillus thuringiensis* subsp. *kurstaki*	150–300 g/ 250 L/4,000 m^2	–	0	Apply at first sign of infestation and repeat at 7 to 10-day intervals when needed to maintain control. Good coverage of all leaves is essential since the insect must ingest the DiPel for insecticidal action.
	Entrust 80 W	spinosad	72 g/1,000 L	12	2	The maximum volume that can be used is 1,000 L/ha. Apply when eggs hatch and first instar larvae are present. Do not apply by a fogger or mister. Monitoring is critical for proper timing of the insecticide. Three applications can be used per crop cycle.
	Foray 48BA Aqueous Concentrate	*Bacillus thuringiensis* subsp. *kurstaki*	0.6–1.8 L in 500–1,000 L/ha	–	0	Apply at the first signs of larval infestations. Repeat applications as necessary to maintain control of young larvae. The exact timing and number of applications will depend on foliage development and larval activity, including extent of egg hatch, stage of larval development and population pressure.
	Pylon	chlorfenapyr	30 mL/100 L	12	0	A maximum of 1 application per crop cycle is allowed. Do not apply as an ultra-low volume spray, nor through any type of irrigation system. Do not use on tomato varieties with a diameter of less than 2.5 cm when mature. Pylon is toxic to bees and other beneficial insects.

Table 4–1. Products Registered for Tomato Insect and Mite Pests *continued*

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Cabbage loopers *Continued*	Success	spinosad	120 mL/1,000 L	12	2	The maximum application volume that can be used is 1,000 L/ha. Apply when eggs hatch and first instar larvae are present. Do not apply by a fogger or mister. Three applications per crop cycle can be used with a minimum of 7 days between applications.
Duponchelia fovealis	Bioprotec 3P Dry Flowable Biological Insecticide	*Bacillus thuringiensis* subsp. *kurstaki*	0.8 kg/1,000 L	–	0	Foliar and drench application. Make application when egg hatch is essentially complete but before crop damage occurs. Apply the product such that it flows along the stem, coating it well, and into the top layer of the soil around the base of the plant. Thorough coverage of foliage and stems is necessary. Re-apply at 7-day intervals, as required by monitoring.
	DiPel 2X DF	*Bacillus thuringiensis* subsp. *kurstaki*	625 g/1,000 L	0	0	Make applications when egg hatch is essentially complete but before crop damage occurs. Apply the product such that it flows along the stem, coating it well, and into the top layer of the soil around the base of the plant. Thorough coverage of foliage and stem is necessary. Apply every 7 days, as required by monitoring.
Earwigs	Insecticidal Soap	potassium salts of fatty acids	2 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage to flowers under high-temperature conditions.
Fungus gnats	VectoBac 600 L	*Bacillus thuringiensis* subsp. *israelensis*	2–8 L/1,000 L	–	0	Do not mix and apply with fertilizers or fungicides containing copper or chlorine as this may neutralize the active ingredients.
Leafminers (exposed stages)	Dibrom	naled	10 mL/100 m^3	48	2	Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry.
Leafminer (*Liriomyza* sp.)	Avid 1.9% EC	abamectin	30 mL/100 L	Do not re-enter treated areas until sprays have dried.	3	Application should be made preferably in 2,000–4,000 L of water/ha. If volumes of water below 2,000 L must be used, apply a minimum of 600 mL Avid 1.9% EC /ha. If volumes of water greater than 4,000 L of water/ha are required for good plant coverage, apply a maximum rate of 1,200 mL Avid 1.9% EC /ha.

Leafrollers	Dibrom	naled	10 mL/100 m³	48	2	Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry.
Lepidopteran leafminer	Confirm 240F	tebufenozide	0.6 L/ha	12	2	Use sufficient volume of water to ensure thorough coverage. Foliar application only. Apply at first egg hatch. Maximum number of applications per crop cycle is 4, if monitoring indicates that it is required. Applications should be made a minimum of 10 days apart.
	Coragen	chlorantraniliprole	200 mL/1,000 L	12	1	Apply at egg hatch. Reapply if monitoring indicates it is necessary. Thorough coverage is important to obtain optimum control. Do not make more than 3 applications per crop cycle.
Mealybugs	Dibrom	naled	10 mL/100 m³	48	2	Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry.
Psyllids	Avid 1.9% EC	abamectin	30 mL/100 L	Do not re-enter treated areas until sprays have dried.	3	Application should be made preferably in 2,000–4,000 L of water/ha. If volumes of water below 2,000 L must be used, apply a minimum of 600 mL/ha. If volumes of water greater than 4,000 L of water/ha are required for good plant coverage, apply a maximum rate of 1,200 mL/ha.
	Insecticidal Soap	potassium salts of fatty acids	2 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage to flowers under high-temperature conditions.
Slugs and snails	Sluggo	ferric phosphate	25–50 kg/ha (2.5–5 g/m²)	–	–	Re-apply bait as needed or at least every 2 weeks if slugs and snails continue to be a problem.

Table 4–1. Products Registered for Tomato Insect and Mite Pests *continued*

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Thrips	BotaniGard WP	*Beauveria bassiana*	500–1,000 g/ 400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.
	Entrust 80 W	spinosad	30 g/1,000 L	12	2	For suppression only. The maximum volume that can be used is 1,000 L/ha. Apply when eggs hatch and first instar larvae are present. Do not apply by a fogger or mister. Monitoring is critical for proper timing of the insecticide. Three applications can be used per crop cycle.
	Success	spinosad	50 mL/1,000 L	12	2	This product is for suppression only of thrips. The maximum application volume that can be used is 2,000 L/ha. Apply when pest first appears. Do not apply by a fogger or mister. Three applications per crop cycle can be used with a minimum of 7 days between applications.
Tobacco budworm *(Heliothis virescens)*	Pylon	chlorfenapyr	30 mL/100 L	12	0	A maximum of 1 application per crop cycle is allowed. Do not apply as an ultra-low volume spray, nor through any type of irrigation system. Do not use on tomato varieties with a diameter of less than 2.5 cm when mature. Pylon is toxic to bees and other beneficial insects.
Tomato hornworm	Bioprotec 3P Dry Flowable Biological Insecticide	*Bacillus thuringiensis* subsp. *kurstaki*	0.46–0.92 kg/ 1,000 L	–	0	Apply to young larvae at first signs of infestation. Repeat applications as necessary to maintain control of young larvae. The timing and number of applications will depend on foliage development and larval activity, including egg hatch, stage of larval development and population pressure.

Tomato hornworm *Continued*	Bioprotec CAF Aqueous Biological Insecticide	*Bacillus thuringiensis* subsp. *kurstaki*	0.9–1.8 L/ 1,000 L	–	0	Apply to young larvae at first signs of infestation. Repeat applications as necessary to maintain control of young larvae. The timing and number of applications will depend on foliage development and larval activity, including egg hatch, stage of larval development and population pressure.
	Pylon	chlorfenapyr	30 mL/100 L	12	0	A maximum of 1 application per crop cycle is allowed. Do not apply as an ultra-low volume spray, nor through any type of irrigation system. Do not use on tomato varieties with a diameter of less than 2.5 cm when mature. Pylon is toxic to bees and other beneficial insects.
Two-spotted spider mites	Avid 1.9% EC	abamectin	30 mL/100 L	Do not re-enter treated areas until sprays have dried.	3	Application should be made preferably in 2,000–4,000 L of water/ha. If volumes of water below 2,000 L must be used, apply a minimum of 600 mL Avid 1.9% EC /ha. If volumes of water greater than 4,000 L of water/ha are required for good plant coverage, apply a maximum rate of 1,200 mL Avid 1.9% EC /ha.
	Dibrom	naled	10 mL/100 m^3	48	2	Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry.
	DynoMite 75 WP	pyridaben	284 g/1,000 L/ha	12	2	The maximum number of applications per crop cycle is two. Apply at intervals of at least 28 days.
	Floramite SC	bifenazate	125 mL/400 L	12	0	Only two applications per crop cycle are allowed.
	Forbid 240 SC	spiromesifen	30–50 mL/100 L	12	3	The maximum number of applications per crop cycle is two.
	Insecticidal Soap	potassium salts of fatty acids	2 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage to flowers under high-temperature conditions.

Table 4–1. Products Registered for Tomato Insect and Mite Pests *continued*

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Two-spotted spider mites *Continued*	Pylon	chlorfenapyr	20-30 mL/100 L	12	0	Use lower concentrations before populations are causing economic damage. A maximum of 1 application per crop cycle is allowed. Do not apply as an ultra-low volume spray, nor through any type of irrigation system. Do not use on tomato varieties with a diameter of less than 2.5 cm when mature. Pylon is toxic to bees and other beneficial insects.
	Shuttle 15SC	acequinocyl	0.21-0.46 L/500 L	12	1	Do not apply more than 2 applications per crop cycle. Thorough coverage is essential for effective control. Application should be made as soon as the mite population reaches economic infestation levels. Apply the higher concentration for heavy pest populations. Allow a minimum of 21 days between applications of Shuttle 15SC.
	Vendex 50 WP	fenbutatin oxide	50 g/100 L	12	5	The addition of a suitable spreader-sticker will usually result in superior mite control on these crops. Begin applications when mites appear, and repeat as necessary to maintain control.
Whiteflies	Ambush 50 EC	permethrin	200 mL/1,000 L	–	1	Apply to achieve thorough coverage. Repeat as necessary.
	Beleaf 50SG	flonicamid	0.2 g/L (20 g/100 L)	12	0	Foliar application. Apply sufficient volume to ensure good coverage. The spray volume can vary from 500-1,000 L/ha depending on the size of the plants. Apply as populations begin to increase but before damaging populations are established. Do not apply more than 2 applications per crop cycle.
	BotaniGard WP	*Beauveria bassiana*	250–500 g/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.

Whiteflies *Continued*	DDVP 20% EC	dichlorvos	6 mL/L	24	7	Crop damage can occur, particularly under hot, humid conditions. Thoroughly ventilate before re-entering on the day following treatment.
	Dibrom	naled	10 mL/100 m^3	48	2	Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry.
	Distance	pyriproxyfen	45 mL/100 L	12	3	The maximum number of applications per crop cycle is two. Make the first application when adults begin to appear.
	Forbid 240 SC	spiromesifen	30–50 mL/100 L	12	3	The maximum number of applications per crop cycle is two.
	Insecticidal Soap	potassium salts of fatty acids	1 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage to flowers under high-temperature conditions.
	Intercept 60 WP	imidacloprid	16 g/60 L/1,000 mature plants	–	1	Do not apply more than once per season. Repellency of bumblebee pollinators and negative effects on some beneficials (*Orius* sp.) can occur.
	Kontos	spirotetramat	30-42 mL/100 L Maximum rate per single application is 300 mL/ha	12	3	Use the higher concentration for higher pest infestation levels. Interval between applications is at least 7-14 days. The maximum number of applications per cropping cycle is 3. A maximum of 900 mL of product is allowed per crop cycle. Do not exceed a spray volume of 712 L/ha (42 ml concentration) to 1,000 L/ha (30 ml concentration). Avoid application during flowering. Residues in/on pollen and nectar may harm bee brood, but the product is not acutely toxic to adult bees. The product is toxic to certain beneficials.
	Met52	*Metarhizium anisopliae* Strain F52	0.5-5.0 L/1,000 L	0	0	Begin application during early stages of population development. Use the higher application concentration when pest pressure is high. An application interval of 5-10 days is recommended. Spray to wet all foliage, but avoid runoff. Do not apply through a thermal pulse fogger. Do not store at high temperatures, and do not mix more Met52 than can be applied within 6 hr of mixing. Do not apply fungicides near the time of application of Met52.

Table 4–1. Products Registered for Tomato Insect and Mite Pests *continued*

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry interval (hr)[2]	Pre-harvest interval (days)[2]	Remarks
Whiteflies *Continued*	Pounce 384 EC	permethrin	260 mL/1,000 L	–	1	Apply to achieve thorough coverage. Repeat as necessary.
	Tristar 70 WSP	acetamiprid	15 packs/2 ha	12	1	A maximum of two applications per year per greenhouse is allowed. Apply through drip irrigation to the growing media. This is the only approved application method.

[1] DF = Dry Flowable; EC = Emulsifiable Concentrate; F = Flowable; SC = Sprayable Concentrate; W, WP = Wettable Powder; WG = Wettable Granules; WSP = Water-Soluble Packs
[2] "–" indicates no information was provided on the product label.

Table 4–2. Products Registered for Tomato Diseases

Disease	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry interval (hr)[2]	Pre-harvest interval (days)[2]	Remarks
Bacterial blight *(Pseudomonas syringae)*	Cease	*Bacillus subtilis* strain QST 713	1.0-2.0 L/100 L water	-	0	Begin application when environmental conditions in the greenhouse are conducive to disease development. Repeat as necessary on a 7 to 10-day interval.
	Regalia Maxx	extract of *Reynoutria sachalinensis*	0.5–1 L/400 L	Do not re-enter treated areas until sprays have dried.	0	This product is for suppression of bacterial blight. Begin applications at first sign of disease, or when conditions become conducive for disease development. Repeat as necessary on a 7 to 10-day interval. Spray until just prior to run-off. Do not apply in a spray volume of more than 1,500 L/ha.
	Rhapsody ASO (aqueous suspension)	*Bacillus subtilis*	1–2 L/100 L	–	0	Apply preventively or in early stages of disease development. Repeat as necessary every 7–10 days. Maintain agitation during mixing and application to ensure uniform coverage. Do not mix in spray tank with pesticides, surfactants or fertilizers.

Bacterial canker	AgriPhage-CMM	Bacteriophage of *Clavibacter michiganensis* subsp. *michiganensis*	Seedlings - 12 mL/100 m² greenhouse space. Greenhouse - 40 mL/100 m² greenhouse space.	-	0	Apply treatments in 3-4 day intervals. Use sufficient water to ensure complete coverage. The spray solution should be used within 24 hours of being prepared.
	Copper Spray Fungicide	copper oxychloride	3 kg/1,000 L/ha	–	1	Apply early in the season and repeat at 7 to 10-day intervals.
	Cyclone	citric and lactic acid	2.4% dilution in water	Do not re-enter treated areas until sprays have dried.	0	Apply every 5–10 days. Use of a surfactant can help achieve better coverage of leaves and better efficacy. For maximum effectiveness, apply prior to, or at early stages of disease development. Apply in sufficient volume to ensure full coverage for effective control. Make sure both leaf sides are treated.
	Kasumin 2L	kasugamycin	1.2 L/ha	12	1	Do not make more than 3 applications per season. A minimum of 7 days between applications is required. Do not make more than 2 consecutive applications. If additional applications are needed, rotate with another product with a different mode of action that is registered for this use.
	Kocide 3000	copper hydroxide	1.86 kg/ha	24	1	Apply to tomato seedlings in propagation every 5 days to a maximum of 5 applications over a 4-week period. Apply to production house tomatoes every 7-10 days.
Bacterial spot ***(Xanthomonas campestris* pv. *vesicatoria)***	Kasumin 2L	kasugamycin	1.2 L/ha	12	1	Do not make more than 3 applications per season. A minimum of 7 days between applications is required. Do not make more than 2 consecutive applications. If additional applications are needed, rotate with another product with a different mode of action that is registered for this use.

Table 4–2. Products Registered for Tomato Diseases *continued*

Disease	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Botrytis grey mould	Botran 75 W	dicloran	1.75 kg/1,000 L	–	1	Seedlings or newly set transplants may be injured by drenching.
	Cease	*Bacillus subtilis* strain QST 713	1.0-2.0 L/100 L water	-	0	Begin application when environmental conditions in the greenhouse are conducive to disease development. Repeat as necessary on a 7 to 10-day interval.
	Decree	fenhexamid	1.5 kg/ha	4	1	Do not make more than three applications per crop cycle.
	Fontelis	penthiopyrad	1.25–1.75 L/ha	12	0	Begin applications prior to disease development and continue on a 7 to 10-day interval. Use higher rate and shorter interval when disease pressure is high. Make no more than 2 sequential applications before switching to a fungicide with a different mode of action.
	Prestop	*Gliocladium catenulatum*	Apply sufficient 0.5% suspension to wet plants, but not to run-off.	4	0	Repeat applications every 3 to 4 weeks. Viability of contents in unopened packets, stored under cool (approx. 4°C), dry conditions, is 12 months. Use entire contents of opened packets on the same day they are opened.
	Pristine WG	boscalid + pyraclostrobin	Apply 1.6 kg/ha in a minimum water volume of 250 L/ha.	Do not re-enter treated areas until sprays have dried.	0	Do not apply more than once per crop cycle. Do not apply this product using any type of fogger or mister.
	Regalia Maxx	extract of *Reynoutria sachalinensis*	1 L/400 L	Do not re-enter treated areas until sprays have dried.	0	This product is for suppression of Botrytis grey mould. Begin applications at first sign of disease, or when conditions become conducive for disease development. Repeat as necessary on a 7 to 10-day interval. Spray until just prior to run-off. Do not apply in a spray volume of more than 1,500 L/ha.
	Rhapsody ASO (aqueous suspension)	*Bacillus subtilis*	1–2 L/100 L	–	0	Apply preventively or in early stages of disease development. Repeat as necessary every 7–10 days. Maintain agitation during mixing and application to ensure uniform coverage. Do not mix in spray tank with pesticides, surfactants or fertilizers.
	RootShield HC Wettable Powder	*Trichoderma harzianum*	3.75–7.5 g/L	4	–	Apply to foliage every 7–14 days depending upon disease pressure.

Botrytis grey mould *Continued*	Rovral 50 WP	iprodione	1 kg/1,000 L	12	2	Spray to run-off, ensuring good coverage of the plants, particularly stem nodes, immediately following any pruning.
	Scala SC	pyrimethanil	2 L/ha	–	1	Do not make more than 2 applications per growing season. Apply at first sign of grey mould or in rotation with other registered products. Ventilate for at least 2 hr after application. Thorough ventilation after spraying is essential to avoid brown or necrotic spots that can be caused by vapour activity of Scala SC.
	StorOx	hydrogen peroxide	100 mL/10 L	Do not re-enter treated areas until sprays have dried.	0	Apply 300–950 L of diluted product per ha. Spray when disease first appears or when conditions are favourable for disease development. Apply diluted spray to the point of run-off to achieve full and even coverage. Toxic to bees and certain beneficial insects exposed to direct contact. Solutions are corrosive to materials that are easily oxidized such as natural rubber, copper, galvanized and black iron pipe.
	Switch 62.5 WG/ Palladium	cyprodinil + fludioxinil	775 g/ha	24	1	First application should be made when disease first appears; a second application should be made 7–10 days later. Do not make more than 2 applications per crop cycle.
Damping-off in seedlings	Actinovate SP	Streptomyces lydicus strain WYEC 108	7.5 to 42 g/300 mL water/kg of seed	1	0	Apply through mist-type commercial seed treatment equipment, slurry, or other comparable methods that provide thorough coverage of treated seeds. Prior to planting, dissolve Actinovate SP in water and spray directly on seed.
	Influence WP	garlic	10-20 kg in 1,000 L water to cover 300 m^2	Do not re-enter treated areas until sprays have dried.	0	Apply as a drench to the substrate surface at seeding. Use the higher rate under high disease pressure or when conditions are conducive to disease development.
	Maestro 80 DF	captan	1.25 kg/1,000 L; apply 50–85 L/ 100 m^2	48	-	Work into the upper 7.5–10 cm of soil before planting.
Early blight	Fontelis	penthiopyrad	1.25–1.75 L/ha	12	0	Begin applications prior to disease development and continue on a 7 to 10-day interval. Use higher rate and shorter interval when disease pressure is high. Make no more than 2 sequential applications before switching to a fungicide with a different mode of action.
	Manzate Pro-Stick	mancozeb	2.4 kg/ha	–	7	Apply every 7 to 12 days to keep new growth covered.

Table 4–2. Products Registered for Tomato Diseases *continued*

Disease	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Fungus root rot diseases	Supra Captan 80 WDG	captan	Use 1.25 kg/ 1,000 L and apply at rates of 50–85 L/100 m².	48	–	Work into the upper 7.5–10 cm of soil before planting.
***Fusarium* spp.**	Mycostop	*Streptomyces griseoviridis*	Immediately after transplanting, apply 10–50 mg/plant or 20–100 mL/plant of 0.05% suspension.	4	0	Repeat treatments at intervals of 3–6 weeks depending on disease pressure.
	RootShield Granules	*Trichoderma harzianum*	Apply 600–750 g/m³ of planting mix or soil.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
	RootShield HC Wettable Powder	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
	RootShield WP	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
Late blight	Influence WP	garlic	6.9 kg/ha	Do not re-enter treated areas until sprays have dried.	0	Applications should be made preventatively or at first signs of disease. Repeat applications at 7-14 day intervals and thorough coverage of foliage is required to maintain suppression of the disease.
	Manzate Pro-Stick	mancozeb	2.4 kg/ha	–	7	Apply every 7 to 12 days to keep new growth covered.
	Revus	mandipropamid	400–600 mL/ha	12	1	Do not apply more than four applications per season. Applications should begin prior to disease development and continue throughout the season on a 7 to 10-day schedule of fungicides, following the resistance management guidelines. Use of a nonionic adjuvant (0.125% v/v) is recommended. Refer to label for recommended water volume.

Late blight *Continued*	Taegro	*Bacillus subtilis* var. *amyloliquefaciens* Strain FZB24	364 g/935.4 L/ha	0	0	Before applying to foliage, stir product to ensure complete suspension. Continue applications at 7-day intervals when conditions are conducive to disease. Store at room temperature, but do not exceed 35°C, and use within 1 yr from date of manufacture.
***Phytophthora* spp.**	Mycostop	*Streptomyces griseoviridis*	Immediately after transplanting, apply 10–50 mg/ plant or 20–100 mL/plant of 0.05% suspension.	4	0	Repeat treatments at intervals of 3–6 weeks depending on disease pressure.
Powdery mildew	Actinovate SP	*Streptomyces lydicus* strain WYEC 108	425–840 g/ 700 L/ha	1	0	Make the first application when conditions are conducive to disease development and repeat application every 7–14 days.
	Influence LC	garlic	18 L/ha	Do not re-enter or allow entry into treated areas until the spray is dried.	0	Add the recommended amount of Influence LC to the required amount of water in the spray tank. Agitate as necessary to maintain suspension. Apply at a rate of 18 L/ha in a recommended dilution rate between 500 to 1,000 L/ha (depending on plant development). Subsequent applications may be made every 7-14 days if symptoms persist.
	Influence WP	garlic	6.9 kg/ha	Do not re-enter treated areas until sprays have dried.	0	Applications should be made preventatively or at first signs of disease. Repeat applications at 7-14 day intervals and thorough coverage of foliage is required to maintain suppression of the disease.
	MilStop	potassium bicarbonate	5.6 kg/ha	4	0	Do not mix with other soluble fertilizers or pesticides. This product is not compatible with mild alkaline solutions. Addition of surfactant or wetting agent is not required.
	Nova 40 W (WSP)	myclobutanil	340 g/ha (1,000 L/ha)	Do not re-enter treated areas until sprays have dried.	3	Apply no more than two applications/year.
	Pristine WG	boscalid + pyraclostrobin	Apply 1.6 kg/ha in a minimum water volume of 250 L/ha.	Do not re-enter treated areas until sprays have dried.	0	Do not apply more than once per crop cycle. Do not apply this product using any type of fogger or mister.
	Sulphur (Bartlett's Microscopic Sulphur 92%)	sulphur	750 g/1,000 L/ha	24	1	A maximum of 10 applications per crop cycle is allowed. This product may cause slight foliage damage.

Table 4–2. Products Registered for Tomato Diseases *continued*

Disease	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Powdery mildew *Continued*	Sulphur - Agrotek Ascend Vaporized Sulphur	sulphur	0.4-3.2 g sulphur/1,000 m^2 per application	Vent greenhouse for a minimum of 2 hr before re-entry. During venting, there should be a minimum of 4 air changes per hr.	-	Run the vaporizer for 1-8 hr per night and repeat 2-7 days per week. See label for general and specific instructions on vaporization of sulphur in the greenhouse.
	Switch 62.5 WG/ Palladium	cyprodinil + fludioxinil	775 g/ha	24	1	First application should be made when disease first appears; a second application should be made 7–10 days later. Make no more than 2 sequential applications before alternating with another registered fungicide with a different mode of action. Do not make more than 3 applications per crop cycle.
Pythium root rot	Actinovate SP	*Streptomyces lydicus* strain WYEC 108	420 to 840 g/ha 42 to 84 g/ 100 L water/1m^3 of growing media	1	0	Apply solution to the growing media. Apply Actinovate immediately after the seed is planted and then repeat application every 7 to 14 days.
	Prestop	*Gliocladium catenulatum*	125–250 mL of 0.5% suspension/ 10 L of growth media, or 100 L of 0.5% suspension/ 2,000 plants	4	0	Repeat applications every 3 to 6 weeks. Viability of contents in unopened packets, stored under cool (approx. 4°C), dry conditions, is 12 months. Use entire contents of opened packets on the same day they are opened.
	Previcur N	propamocarb hydrochloride	Use 10 mL/10 L of water and apply this solution at a rate of 100–200 mL/plant. Use higher rate for 2nd and 3rd applications.	12	1	A maximum of four applications per crop cycle is allowed — no more than two applications on seedlings and no more than two applications after transplanting. Occasional slight damage may occur following overhead drenching of recently planted seedlings.

Pythium root rot *Continued*	RootShield Granules	*Trichoderma harzianum*	Apply 600–750 g/m³ of planting mix or soil.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
	RootShield HC Wettable Powder	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
	RootShield WP	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
***Rhizoctonia* sp.**	Prestop	*Gliocladium catenulatum*	Apply 125–250 mL of 0.5% suspension/ 10 L of growth media, or 100 L of 0.5% suspension/ 2,000 plants.	4	0	Repeat applications every 3 to 6 weeks. Viability of contents in unopened packets, stored under cool (approx. 4°C), dry conditions, is 12 months. Use entire contents of opened packets on the same day they are opened.
	RootShield Granules	*Trichoderma harzianum*	Apply 600–750 g/m³ planting mix or soil.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
	RootShield HC Wettable Powder	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
	RootShield WP	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
Septoria leaf spot	Manzate Pro-Stick	mancozeb	2.4 kg/ha	–	7	Apply every 7 to 12 days to keep new growth covered.

[1] DF = Dry Flowable; SC = Sprayable Concentrate; W, WP = Wettable Powder; WDG = Water Dispersible Granules; WG = Wettable Granules; WSP = Water-Soluble Packs

[2] "–" indicates no information was provided on the product label.

5. Cucumbers

Products registered for insect and mite pests of cucumber are listed in Table 5–1, *Products Registered for Cucumber Insect and Mite Pests*. Products registered for cucumber diseases are listed in Table 5–2, *Products Registered for Cucumber Diseases*.

Table 5–1. Products Registered for Insect and Mite Pests of Cucumber

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Aphids	Beleaf 50SG	flonicamid	Foliar - 0.3 g/L (30 g/100 L) Drip irrigation - 12.5 mg/plant	12	0	Foliar application - apply sufficient volume to ensure good coverage, up to 1,000 L/ha. Do not apply more than 1 foliar application per crop cycle. Apply using drip irrigation or drench by hand using sufficient volume to ensure delivery of the product to the roots. See Chemigation Section of label for additional information on drip irrigation. Do not apply more than 2 applications per crop cycle. Allow a minimum of 7 days between applications. Apply as populations begin to increase but before damaging populations are established.
	BotaniGard ES	*Beauveria bassiana*	0.5–1 L/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.
	BotaniGard WP	*Beauveria bassiana*	250–500 g/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.
	DDVP 20% EC	dichlorvos	6 mL/L	24	7	Crop damage can occur, particularly under hot, humid conditions. Thoroughly ventilate before re-entering on the day following treatment.

Table 5–1. Products Registered for Insect and Mite Pests of Cucumber *continued*

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Aphids *Continued*	Dibrom	naled	10 mL/100 m³	48	2	Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry.
	Endeavor 50 WG	pymetrozine	Apply 100–200 g/ha in a minimum of 1,000 L/ha.	12	3	Do not exceed two applications per crop cycle. Do not apply more than three applications per greenhouse per year in greenhouses with multiple crop cycles. Do not reapply for at least 7 days. On hard-to-wet plants add a nonionic or organosilicone-based surfactant to improve coverage.
	Insecticidal Soap	potassium salts of fatty acids	2 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage to flowers under high-temperature conditions.
	Intercept 60 WP	imidacloprid	16 g/80 L/1,000 mature plants	–	1	Do not apply more than once per season. Negative effects on some beneficials (e.g. Orius sp.) can occur.
	Kontos	spirotetramat	30-42 mL/100 L Maximum rate per single application is 300 mL/ha	12	3	Use the higher concentration for higher pest infestation levels. Interval between applications is at least 7-14 days. The maximum number of applications per cropping cycle is 3. A maximum of 900 mL of product is allowed per crop cycle. Do not exceed a spray volume of 712 L/ha (42 ml concentration) to 1,000 L/ha (30 ml concentration).
Banana moth *(Opogona sacchari)*	Bioprotec 3P Dry Flowable Biological Insecticide	*Bacillus thuringiensis* subsp. *kurstaki*	0.8 kg/1,000 L	–	0	Foliar application. Make application just prior to egg hatch. Apply the product such that it flows along the stem, coating it well. Thorough coverage of foliage and stems is necessary (minimum of 300 L of water per hectare). Reapply at 7-day intervals, as required by monitoring.
Cabbage loopers	Bioprotec 3P Dry Flowable Biological Insecticide	*Bacillus thuringiensis* subsp. *kurstaki*	0.92 kg/1,000 L	–	0	Apply to young larvae at first signs of infestation. Repeat applications as necessary to maintain control of young larvae. The timing and number of applications will depend on foliage development and larval activity, including egg hatch, stage of larval development and population pressure.
	Bioprotec CAF Aqueous Biological Insecticide	*Bacillus thuringiensis* subsp. *kurstaki*	1.8 L/1,000 L	–	0	Apply to young larvae at first signs of infestation. Repeat applications as necessary to maintain control of young larvae. The timing and number of applications will depend on foliage development and larval activity, including egg hatch, stage of larval development and population pressure.

Cabbage loopers *Continued*	Coragen	chlorantraniliprole	125 mL/1,000 L	12	1	Begin applications when treatment thresholds have been reached. Thorough coverage is required to obtain optimum control. Repeat applications if monitoring indicates it is necessary. Do not make more than 3 applications per crop cycle.
	Entrust 80 W	spinosad	72 g/1,000 L	12	2	Maximum volume that can be used is 1,000 L/ha. Apply when eggs hatch and first instar larvae are present. Do not apply by a fogger or mister. Monitoring is critical for proper timing of the insecticide. Three applications can be used per crop cycle.
	Foray 48BA Aqueous Concentrate	*Bacillus thuringiensis* subsp. *kurstaki*	0.6–1.8 L in 500–1,000 L/ha	–	0	Apply at the first signs of larval infestations. Repeat applications as necessary to maintain control of young larvae. The exact timing and number of applications will depend on foliage development and larval activity, including extent of egg hatch, stage of larval development and population pressure.
	Success	spinosad	120 mL/1,000 L	12	2	The maximum application volume that can be used is 1,000 L/ha. Apply when eggs hatch and first instar larvae are present. Do not apply by a fogger or mister. Three applications per crop cycle can be used with a minimum of 7 days between applications.
Duponchelia fovealis	Bioprotec 3P Dry Flowable Biological Insecticide	*Bacillus thuringiensis* subsp. *kurstaki*	0.8 kg/1,000 L	–	0	Foliar and drench application. Make application when egg hatch is essentially complete but before crop damage occurs. Apply the product such that it flows along the stem, coating it well, and into the top layer of the soil around the base of the plant. Thorough coverage of foliage and stems is necessary. Reapply at 7-day intervals, as required by monitoring.
	DiPel 2X DF	*Bacillus thuringiensis* subsp. *kurstaki*	625 g/1,000 L	–	0	Make applications when egg hatch is essentially complete but before crop damage occurs. Apply the product such that it flows along the stem, coating it well, and into the top layer of the soil around the base of the plant. Thorough coverage of foliage and stem is necessary. Apply every 7 days as required by monitoring.
Earwigs	Insecticidal Soap	potassium salts of fatty acids	2 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage to flowers under high-temperature conditions.
Fungus gnats	VectoBac 600 L	*Bacillus thuringiensis* subsp. *israelensis*	2–8 L/1,000 L	–	0	Do not mix and apply with fertilizers or fungicides containing copper or chlorine as this may neutralize the active ingredients.
Leafminer (*Liriomyza* spp.)	Avid 1.9% EC	abamectin	30 mL/100 L	Do not re-enter treated areas until sprays have dried.	3	Application should be made preferably in 2,000–4,000 L of water/ha. If volumes of water below 2,000 L must be used, apply a minimum of 600 mL Avid 1.9% EC /ha. If volumes of water greater than 4,000 L of water/ha are required for good plant coverage, apply a maximum rate of 1,200 mL Avid 1.9% EC /ha.

Table 5–1. Products Registered for Insect and Mite Pests of Cucumber *continued*

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Leafrollers	Dibrom	naled	10 mL/100 m³	48	2	Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry.
Mealybugs	Dibrom	naled	10 mL/100 m³	48	2	Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry.
Psyllids	Insecticidal Soap	potassium salts of fatty acids	2 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage to flowers under high-temperature conditions.
Slugs & snails	Sluggo	ferric phosphate	25–50 kg/ha (2.5–5 g/m²)	–	–	Re-apply bait as needed or at least every 2 weeks if slugs and snails continue to be a problem.
Thrips	Beleaf 50SG	flonicamid	Foliar - 0.3 g/L (30 g/100 L) Drip irrigation - 12.5 mg/plant	12	0	Foliar application - apply sufficient volume to ensure good coverage, up to 1,000 L/ha. Do not apply more than 1 foliar application per crop cycle. Apply using drip irrigation or drench by hand using sufficient volume to ensure delivery of the product to the roots. See Chemigation Section of label for additional information on drip irrigation. Do not apply more than 2 applications per crop cycle. Allow a minimum of 7 days between applications. Apply as populations begin to increase but before damaging populations are established.
	BotaniGard ES	*Beauveria bassiana*	2 L/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.

Thrips *Continued*	BotaniGard WP	*Beauveria bassiana*	500–1,000 g/ 400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.
	Entrust 80 W	spinosad	30 g/1,000 L	12	2	For suppression only of thrips. Maximum volume that can be used is 2,000 L/ha. Apply when pest first appears. Do not apply by a fogger or mister. Monitoring is critical for proper timing of the insecticide. Three applications can be used per crop cycle.
	Success	spinosad	50 mL/1,000 L	12	2	This product is for suppression only of thrips. The maximum application volume that can be used is 2,000 L/ha. Apply when pest first appears. Do not apply by a fogger or mister. Three applications per crop cycle can be used with a minimum of 7 days between applications.
Two-spotted spider mite	Avid 1.9% EC	abamectin	30 mL/100 L	Do not re-enter treated areas until sprays have dried.	3	Application should be made preferably in 2,000–4,000 L of water/ ha. If volumes of water below 2,000 L must be used, apply a minimum of 600 mL Avid 1.9% EC /ha. If volumes of water greater than 4,000 L of water/ha are required for good plant coverage, apply a maximum rate of 1,200 mL Avid 1.9% EC /ha.
	Dibrom	naled	10 mL/100 m^3	48	2	Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry.
	DynoMite 75 WP	pyridaben	Apply 284 g/ha using 1,000 L/ha.	12	2	The maximum number of applications per crop cycle is two. Apply at intervals of at least 28 days.
	Floramite	bifenazate	125 L/400 L	12	1	Only two applications per crop cycle are allowed.
	Forbid 240 SC	spiromesifen	30–50 mL/100 L	12	3	The maximum number of applications per crop cycle is two.
	Insecticidal Soap	potassium salts of fatty acids	2 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage to flowers under high-temperature conditions.
	Shuttle 15SC	acequinocyl	0.21-0.46 L/500 L	12	1	Do not apply more than 2 applications per crop. Thorough coverage is essential for effective control. Application should be made as soon as the mite population reaches economic infestation levels. Apply the higher concentration for heavy pest populations. Allow a minimum of 21 days between applications of Shuttle 15SC.

Table 5–1. Products Registered for Insect and Mite Pests of Cucumber *continued*

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Two-spotted spider mite *Continued*	Vendex 50 WP	fenbutatin oxide	50 g/100 L	12	3	The addition of a suitable spreader-sticker will usually result in superior mite control on these crops. Begin applications when mites appear, and repeat as necessary to maintain control.
Whiteflies	Ambush 50 EC	permethrin	200 mL/1,000 L	–	1	Apply to achieve thorough coverage. Repeat as necessary.
	BotaniGard ES	*Beauveria bassiana*	0.5–1 L/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.
	BotaniGard WP	*Beauveria bassiana*	250–500 g/ 400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.
	DDVP 20% EC	dichlorvos	6 mL/L	24	7	Crop damage can occur, particularly under hot, humid conditions. Thoroughly ventilate before re-entering on the day following treatment.
	Dibrom	naled	10 mL/100 m^3	48	2	Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry.
	Distance	pyriproxyfen	45 mL/100 L	12	3	The maximum number of applications per crop cycle is two. Make the 1st application when adults begin to appear.
	Forbid 240 SC	spiromesifen	30–50 mL/100 L	12	3	The maximum number of applications per crop cycle is two.
	Insecticidal Soap	potassium salts of fatty acids	1 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage to flowers under high-temperature conditions.
	Intercept 60 WP	imidacloprid	16 g/80 L/1,000 mature plants	–	1	Do not apply more than once per season. Negative effects on some beneficials (*Orius* sp.) can occur.

Whiteflies *Continued*	Kontos	spirotetramat	30-42 mL/100 L Maximum rate per single application is 300 mL/ha	12	3	Use the higher concentration for higher pest infestation levels. Interval between applications is at least 7-14 days. The maximum number of applications per cropping cycle Is 3. A maximum of 900 mL of product is allowed per crop cycle. Do not exceed a spray volume of 712 L/ha (42 ml concentration) to 1,000 L/ha (30 ml concentration).
	Pounce 384 EC	permethrin	260 mL/1,000 L	–	1	Apply to achieve thorough coverage. Repeat as necessary.

[1] DF = Dry Flowable; EC = Emulsifiable Concentrate; ES = Emulsifiable Suspension; SC = Sprayable Concentrate; W, WP = Wettable Powder; WG = Wettable Granules

[2] "–" indicates no information was provided on the product label.

Table 5–2. Products Registered for Cucumber Diseases

Disease	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Botrytis cinerea	Fontelis	penthiopyrad	1–1.5 L/ha	12	1	Begin applications prior to disease development and continue on a 7 to 14-day interval. Use higher rate and shorter interval when disease pressure is high. Make no more than 2 sequential applications before switching to a fungicide with a different mode of action.
	Prestop	*Gliocladium catenulatum*	Apply sufficient 0.5% suspension to wet plants, but not to run-off.	4	0	Repeat applications every 3 to 4 weeks. Viability of contents in unopened packets, stored under cool (approx. 4°C), dry conditions, is 12 months. Use entire contents of opened packets on the same day they are opened.
	Rovral	iprodione	1 kg/1,000 L	12	2	Spray to run-off ensuring good coverage of the plants, particularly stem nodes immediately following any pruning.
Cercospora leaf spot *(Cercospora citrullina)*	Cease	*Bacillus subtilis* strain QST 713	1.0-2.0 L/100 L water	-	0	Begin application when environmental conditions in the greenhouse are conducive to disease development e.g. high humidity, very vegetative growth, water condensate on the leaves etc. Repeat as necessary on a 7 to 10-day interval.
	Rhapsody ASO (aqueous suspension)	*Bacillus subtilis*	1–2 L/100 L	–	0	Apply preventively or in early stages of disease development. Repeat as necessary every 7–10 days. Maintain agitation during mixing and application to ensure uniform coverage. Do not mix with pesticides, surfactants or fertilizers.

Table 5–2. Products Registered for Cucumber Diseases *continued*

Disease	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Damping-off in seedlings	Actinovate SP	*Streptomyces lydicus* strain WYEC 108	7.5 to 42 g/300 mL water/kg of seed	1	0	Apply through mist-type commercial seed treatment equipment, slurry, or other comparable methods that provide thorough coverage of treated seeds. Prior to planting, dissolve Actinovate SP in water and spray directly on seed.
	Influence WP	garlic	10-20 kg in 1,000 L water to cover 300 m^2	Do not re-enter treated areas until sprays have dried.	0	Apply as a drench to the substrate surface at seeding. Use the higher rate under high disease pressure or when conditions are conducive to disease development.
Downy mildew (*Pseudo-peronspora cubensis*)	Cease	*Bacillus subtilis* strain QST 713	1.0-2.0 L/100 L water	-	0	Begin application when environmental conditions in the greenhouse are conducive to disease development e.g. high humidity, very vegetative growth, water condensate on the leaves etc. Repeat as necessary on a 7 to 10-day interval.
	Cyclone	citric and lactic acid	8% dilution in water	Do not re-enter treated areas until sprays have dried.	0	Apply every 7–10 days. Use of a surfactant can help achieve better coverage of leaves and better efficacy. For maximum effectiveness, apply prior to, or at early stages of disease development. Apply in sufficient volume to ensure full coverage for effective control. Make sure both leaf sides are treated.
	Influence WP	garlic	6.9 kg/ha	Do not re-enter treated areas until sprays have dried.	0	Applications should be made preventatively or at first signs of disease. Repeat applications at 7-14 day intervals and thorough coverage of foliage are required to maintain suppression of the disease.
	Previcur N	propamocarb hydrochloride	1.5 L/ha	12	2	A maximum of 1 application is allowed per crop cycle. Ensure that the entire cucumber leaf, particularly the undersides, are well covered with spray solution.
	Revus	mandipropamid	400 mL/ha with 1.5 L Previcur N	12	2	For use in the greenhouse only - not for greenhouse grown seedlings to be planted in the field. Only 1 application is allowed per crop cycle. The use of a non-ionic adjuvant (0.125% v/v) is recommended. Do not apply by chemigation.
	Rhapsody ASO (aqueous suspension)	*Bacillus subtilis*	1.0–2.0 L/100 L	–	0	Apply preventively or in early stages of disease development. Repeat as necessary every 7–10 days. Maintain agitation during mixing and application to ensure uniform coverage. Do not mix in spray tank with pesticides, surfactants or fertilizers.

***Fusarium* spp.**	Mycostop	*Streptomyces griseoviridis*	Immediately after transplanting, apply 10–50 mg/plant or 20–100 mL/ plant of 0.05% suspension.	4	0	Repeat treatments at intervals of 3–6 weeks depending on disease pressure.
	Prestop	*Gliocladium catenulatum*	Apply 125–250 mL of 1% suspension/ 10 L of growth media, or 100 L of 1% suspension per 2,000 plants.	4	0	Repeat applications every 3 to 6 weeks. Viability of contents in unopened packets, stored under cool (approx. 4°C), dry conditions, is 12 months. Use entire contents of opened packets on the same day they are opened.
	RootShield Granules	*Trichoderma harzianum*	Apply 600–750 g/m³ of planting mix or soil.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
	RootShield HC Wettable Powder	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
	RootShield WP	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
Gummy stem blight	Cease	*Bacillus subtilis* strain QST 713	1.0-2.0 L/100 L water	-	0	Begin application when environmental conditions in the greenhouse are conducive to disease development e.g. high humidity, very vegetative growth, water condensate on the leaves etc. Repeat as necessary on a 7 to 10-day interval.
	Nova 40 W	myclobutanil	340 g/ha	Do not re-enter treated areas until sprays have dried.	2	Do not apply more than six times per year.
	Prestop	*Gliocladium catenulatum*	Apply sufficient 1% suspension to wet plants, but not to run-off.	4	0	Repeat applications every 3 to 4 weeks. Viability of contents in unopened packets, stored under cool (approx. 4°C), dry conditions, is 12 months. Use entire contents of opened packets on the same day they are opened.
	Pristine WG	boscalid + pyraclostrobin	Apply 1.3 kg/ha in a minimum water volume of 250 L/ha.	Do not re-enter treated areas until sprays have dried.	0	Do not apply more than once per crop cycle. Do not apply this product using any type of fogger or mister.

Table 5–2. Products Registered for Cucumber Diseases *continued*

Disease	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Gummy stem blight *Continued*	Rhapsody ASO (aqueous suspension)	*Bacillus subtilis*	1–2 L/100 L	–	0	Apply preventively or in early stages of disease development. Repeat as necessary every 7–10 days. Maintain agitation during mixing and application to ensure uniform coverage. Do not mix with pesticides, surfactants or fertilizers.
	Rovral	iprodione	1 kg/1,000–2,000 L/ha	12	2	Spray to run-off ensuring good coverage of the plants, particularly stem nodes immediately following any pruning.
Powdery mildew	Actinovate SP	*Streptomyces lydicus* strain WYEC 108	420 g/470–800 L/ha	1	–	Make the first application when conditions are conducive to disease development and repeat application every 7–14 days.
	Cease	*Bacillus subtilis* strain QST 713	1.0-2.0 L/100 L water	-	0	Begin application when environmental conditions in the greenhouse are conducive to disease development. Repeat as necessary on a 7 to 10-day interval.
	Cyclone	citric and lactic acid	8% dilution in water	Do not re-enter treated areas until sprays have dried.	0	Apply every 7–10 days. Use of a surfactant can help achieve better coverage of leaves and better efficacy. For maximum effectiveness, apply prior to, or at early stages of disease development. Apply in sufficient volume to ensure full coverage for effective control. Make sure both leaf sides are treated.
	Fontelis	penthiopyrad	1.25 L/ha	12	1	Begin applications prior to disease development and continue on a 7 to 14-day interval. Make no more than 2 sequential applications before switching to a fungicide with a different mode of action.
	Influence LC	garlic	18 L/ha	Do not re-enter or allow entry into treated areas until the spray is dried.	0	Use Influence LC at 0.45% v/v in tank mix with Cyclone at 0.3% v/v without surfactant. Ensure thorough coverage. Add the recommended amount of Influence LC to the required amount of water in the spray tank. Agitate as necessary to maintain suspension. Apply at a rate of 18 L/ha in a recommended dilution rate between 500 to 1,000L/ha (depending on plant development). Subsequent applications may be made every 7-14 days if symptoms persist.

Powdery mildew *Continued*	Influence WP	garlic	6.9 kg/ha	Do not re-enter treated areas until sprays have dried.	0	Applications should be made preventatively or at first signs of disease. Repeat applications at 7-14 day intervals and thorough coverage of foliage are required to maintain suppression of the disease.
	Kumulus DF	sulphur	120 g/100 L	24	1	Apply once every 5 days as required.
	Microscopic Sulphur WP	sulphur	105 g/100 L	24	1	Do not apply Microscopic Sulphur Fungicide if high temperature (above 25°C) and high humidity prevail or are expected during the three days following application.
	Microthiol Disperss	sulphur	120 g/100 L	24	1	Do not apply more than 0.04 kg/ha/application during periods of high temperatures.
	MilStop	potassium bicarbonate	5.6 kg/ha	4	0	Do not mix with other soluble fertilizers or pesticides; this product is not compatible with mild alkaline solutions. Addition of surfactant or wetting agent is not required.
	Nova 40 W (WSP)	myclobutanil	340 g/ha	Do not re-enter treated areas until sprays have dried.	2	Do not apply more than six times per year.
	Pristine WG	boscalid + pyraclostrobin	Apply 1.3 kg/ha in a minimum water volume of 250 L/ha.	Do not re-enter treated areas until sprays have dried.	0	Do not apply more than once per crop cycle. Do not apply this product using any type of foggers or misters.
	Rhapsody ASO (aqueous suspension)	*Bacillus subtilis*	1–2 L/100 L	–	0	Apply preventively or in early stages of disease development. Repeat as necessary every 7–10 days. Maintain agitation during mixing and application to ensure uniform coverage. Do not mix with pesticides, surfactants or fertilizers.
	Regalia Maxx	extract of *Reynoutria sachalinensis*	0.5–1 L/400 L	Do not re-enter treated areas until sprays have dried.	0	This product is for suppression of powdery mildew. Begin applications at first sign of disease, or when conditions become conducive for disease development. Repeat as necessary on a 7 to 10-day interval. Spray until just prior to run-off. Do not apply in a spray volume of more than 1,500 L/ha.
	Switch 62.5 WG/ Palladium	cyprodinil + fludioxinil	775 g/ha	24	1	First application should be made when disease first appears; a second application should be made 7–10 days later. Make no more than 2 sequential applications before alternating with another registered fungicide with a different mode of action. Do not make more than 3 applications per crop cycle.

Table 5–2. Products Registered for Cucumber Diseases *continued*

Disease	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Pythium root rot	Actinovate SP	*Streptomyces lydicus* strain WYEC 108	420 to 840 g/ha 42 to 84 g/100 L water/1m³ of growing media	1	0	Apply solution to the growing media. Apply Actinovate immediately after the seed is planted and then repeat application every 7 to 14 days.
	Mycostop	*Streptomyces griseoviridis*	Immediately after transplanting, apply 10-50 mg/ plant or 20–100 mL/plant of 0.05% suspension.	4	0	Repeat treatments at intervals of 3–6 weeks depending on disease pressure.
	Prestop	*Gliocladium catenulatum*	Apply 125–250 mL of 0.5% suspension/ 10 L of growth media, or 100 L of 0.5% suspension/2,000 plants.	4	0	Repeat applications every 3 to 6 weeks. Viability of contents in unopened packets, stored under cool (approx. 4°C), dry conditions, is 12 months. Use entire contents of opened packets on the same day they are opened.
	Previcur N	propamocarb hydrochloride	Use 10 mL/10 L and apply this solution at a rate of 100–200 mL/plant. Use higher rate for 2nd and 3rd applications.	12	2	The maximum number of applications per crop cycle is four; no more than two applications on seedlings, and no more than two applications after transplanting. Occasional slight damage may occur following overhead drenching of recently planted seedlings.
	Ridomil Gold 480 EC or Ridomil Gold 480 SL	metalaxyl-M	Apply 250 mL of solution (0.75–1.25 mL product/ 10 L water).	12	21	Apply once per crop cycle, immediately after transplanting, as a drench to the growing media at the base of each plant; this product cannot be used for cucumbers grown in soil. Do not use in the propagation house. Do not apply to cucumbers intended for field production.
	RootShield Granules	*Trichoderma harzianum*	Apply 600–750 g/m³ of planting mix or soil.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
	RootShield HC Wettable Powder	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.

Pythium root rot *Continued*	RootShield WP	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
Rhizoctonia solani	Prestop	*Gliocladium catenulatum*	Apply 125–250 mL of 0.5% suspension/ 10 L of growth media, or 100 L of 0.5% suspension per 2,000 plants.	4	0	Repeat applications every 3 to 6 weeks. Viability of contents in unopened packets, stored under cool (approx. 4°C), dry conditions, is 12 months. Use entire contents of opened packets on the same day they are opened.
	RootShield Granules	*Trichoderma harzianum*	Apply 600–750 g/m³ of planting mix or soil.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
	RootShield HC Wettable Powder	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
	RootShield WP	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.

[1] DF = Dry Flowable; EC = Emulsifiable Concentrate; SL = Solution; W, WP = Wettable Powder; WG = Wettable Granules; WSP = Water-Soluble Packs

[2] "–" indicates no information was provided on the product label.

6. Peppers

Products registered for insect and mite pests of pepper are listed in Table 6–1, *Products Registered for Pepper Insect and Mite Pests.* Products registered for pepper diseases are listed in Table 6–2, *Products Registered for Pepper Diseases.*

Table 6–1. Products Registered for Insect and Mite Pests of Pepper

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Alfalfa looper *(Autographa californica)*	Pylon	chlorfenapyr	30 mL/100 L	12	0	A maximum of 1 application per crop cycle is allowed. Do not apply as an ultra-low volume spray, nor through any type of irrigation system. Pylon is toxic to bees and other beneficial insects.
Aphids	BotaniGard ES	*Beauveria bassiana*	0.5–1 L/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.
	BotaniGard WP	*Beauveria bassiana*	250–500 g/ 400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.
	Diazinon 500 EC	diazinon	575 mL/625 L (this is equivalent to 230 mL/250 L over 4,000 m^2)	–	5	Use conventional high-volume power sprayers.

Table 6–1. Products Registered for Insect and Mite Pests of Pepper *continued*

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Aphids *Continued*	Dibrom	naled	Vapour: 10 mL/100 m^3 Fog: 7–14 mL per 100 m^2	48	NA	Vapour treatment: Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry. Fogging: Apply with automated fogging equipment only. All workers must vacate premises during the fogging operation. One application per crop cycle, after the last harvest at the end of the cropping cycle.
	Endeavor 50 WG	pymetrozine	100–200 g/ha in a minimum of 1,000 L/ha	12	3	Do not exceed two applications per crop cycle. Do not apply more than three applications per greenhouse per year in greenhouses with multiple crop cycles. Do not reapply for at least 7 days. On hard-to-wet plants add a nonionic or organosilicone-based surfactant to improve coverage.
	Insecticidal Soap	potassium salts of fatty acids	2 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage to flowers under high-temperature conditions.
	Intercept 60 WP	imidacloprid	**For transplant tray plug drench**, apply 4.1 g/1,000 seedlings in a solution application rate of 8 L/100 m^2 of seedling trays. **For mature plants**, apply 16 g in 70 L/1,000 plants.	–	3	**Transplants:** Apply to 2–3-week-old seedlings in flats. Make one application per growing season. **Mature plants:** Applications should be made when infestation pressure surpasses threshold and beneficials are not able to maintain pest populations below damage thresholds. Do not apply more than once per season. Repellency of bumblebee pollinators and negative effects on some beneficials (e.g. *Orius* sp.) can occur.

Aphids *Continued*	Kontos	spirotetramat	30-42 mL/100 L Maximum rate per single application is 300 mL/ha	12	3	Use the higher concentration for higher pest infestation levels. Interval between applications is at least 7-14 days. The maximum number of applications per cropping cycle is 3. A maximum of 900 mL of product is allowed per crop cycle. Do not exceed a spray volume of 712 L/ha (42 ml concentration) to 1,000 L/ha (30 ml concentration). Avoid application during flowering. Residues in/on pollen and nectar may harm bee brood, but the product is not acutely toxic to adult bees. The product is toxic to certain beneficials.
	Tristar 70 WSP	acetamiprid	3 water-soluble packs/1,000 L	12	3	Do not exceed five packs/ha. Do not make more than two applications per year. Do not apply when bees are present in the area to be treated.
Banana moth *(Opogona sacchari)*	Bioprotec 3P Dry Flowable Biological Insecticide	*Bacillus thuringiensis* subsp. *kurstaki*	0.8 kg/1,000 L	–	0	Foliar application. Make application just prior to egg hatch. Apply the product such that it flows along the stem, coating it well. Thorough coverage of foliage and stems is necessary. Reapply at 7-day intervals, as required by monitoring.
Cabbage loopers	Bioprotec 3P Dry Flowable Biological Insecticide	*Bacillus thuringiensis* subsp. *kurstaki*	0.92 kg/1,000 L	–	0	Apply to young larvae at first signs of infestation. Repeat applications as necessary to maintain control of young larvae. The timing and number of applications will depend on foliage development and larval activity, including egg hatch, stage of larval development and population pressure.
	Bioprotec CAF Aqueous Biological Insecticide	*Bacillus thuringiensis* subsp. *kurstaki*	1.8 L/1,000 L	–	0	Apply to young larvae at first signs of infestation. Repeat applications as necessary to maintain control of young larvae. The timing and number of applications will depend on foliage development and larval activity, including egg hatch, stage of larval development and population pressure.
	Confirm 240 F	tebufenozide	0.6 L/ha	12	3	Do not exceed four applications/year. Foliar application only. Applications should be made a minimum of 7 days apart.
	Coragen	chlorantraniliprole	125 mL/1,000 L	12	1	Begin applications when treatment thresholds have been reached. Thorough coverage is required to obtain optimum control. Repeat applications if monitoring indicates it is necessary. Do not make more than 3 applications per crop cycle.
	DiPel 2X DF	*Bacillus thuringiensis* subsp. *kurstaki*	75–150 g/250 L per 4,000 m^2	–	0	Apply to upper and lower portions of the leaves to run-off. Repeat applications will be necessary if a new hatch occurs.

Table 6–1. Products Registered for Insect and Mite Pests of Pepper *continued*

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Cabbage loopers *Continued*	DiPel WP	*Bacillus thuringiensis* subsp. *kurstaki*	150–300 g/ 250 L/4,000 m^2	–	0	Apply at first sign of infestation and repeat at 7 to 10-day intervals when needed to maintain control. Good coverage of all leaves is essential since the insect must ingest the DiPel for insecticidal action.
	Entrust 80 W	spinosad	72 g/1,000 L	12	2	Maximum volume that can be used is 1,000 L/ha. Apply when eggs hatch and first instar larvae are present. Do not apply by a fogger or mister. Monitoring is critical for proper timing of the insecticide. Three applications can be used per crop cycle.
	Foray 48BA Aqueous Concentrate	*Bacillus thuringiensis* subsp. *kurstaki*	0.6–1.8 L in 500–1,000 L/ha	–	0	Apply at the first signs of larval infestations. Repeat applications as necessary to maintain control of young larvae. The exact timing and number of applications will depend on foliage development and larval activity, including extent of egg hatch, stage of larval development and population pressure.
	Pylon	chlorfenapyr	30 mL/100 L	12	0	A maximum of 1 application per crop cycle is allowed. Do not apply as an ultra-low volume spray, nor through any type of irrigation system. Do not use on tomato varieties with a diameter of less than 2.5 cm when mature. Pylon is toxic to bees and other beneficial insects.
	Success	spinosad	120 mL/1,000 L	12	2	The maximum application volume that can be used is 1,000 L/ha. Apply when eggs hatch and first instar larvae are present. Do not apply by a fogger or mister. Three applications per crop cycle can be used with a minimum of 7 days between applications.

Duponchelia fovealis	Bioprotec 3P Dry Flowable Biological Insecticide	*Bacillus thuringiensis* subsp. *kurstaki*	0.8 kg/1,000 L	–	0	Foliar and drench application. Make application when egg hatch is essentially complete but before crop damage occurs. Apply the product such that it flows along the stem, coating it well, and into the top layer of the soil around the base of the plant. Thorough coverage of foliage and stems is necessary. Reapply at 7-day intervals, as required by monitoring.
	DiPel 2X DF	*Bacillus thuringiensis* subsp. *kurstaki*	625 g/1,000 L	–	0	Make applications when egg hatch is essentially complete but before crop damage occurs. Apply the product such that it flows along the stem, coating it well, and into the top layer of the soil around the base of the plant. Thorough coverage of foliage and stem is necessary. Apply every 7 days as required by monitoring.
Earwigs	Insecticidal Soap	potassium salts of fatty acids	2 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage to flowers under high-temperature conditions.
European corn borer	Confirm 240 F	tebufenozide	0.5 L/4,000 L/ha	12	3	Ensure good coverage is achieved and apply at intervals of approximately 7 days. Do not exceed four applications per year.
	Entrust 80 W	spinosad	30 g/1,000 L	12	2	The maximum volume that can be used is 2,000 L/ha. Apply when eggs hatch and first instar larvae are present. Do not apply by a fogger or mister. Monitoring is critical for proper timing of the insecticide. Three applications can be used per crop cycle.
	Success	spinosad	50 mL/1,000 L	12	2	The maximum application volume that can be used is 2,000 L/ha. Apply when eggs hatch and first instar larvae are present. Do not apply by a fogger or mister. Three applications per crop cycle can be used with a minimum of 7 days between applications.
Fungus gnats	VectoBac 600 L	*Bacillus thuringiensis* subsp. *israelensis*	2–8 L/1,000 L	–	0	Do not mix or apply with fertilizers or fungicides containing copper or chlorine as this may neutralize the active ingredients.
Leafrollers	Dibrom	naled	Vapour: 10 mL/100 m^3 Fog: 7–14 mL/100 m^2	48	NA	Vapour treatment: Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry. Fogging: Apply with automated fogging equipment only. All workers must vacate premises during the fogging operation. One application per crop cycle, after the last harvest at the end of the cropping cycle.

Table 6–1. Products Registered for Insect and Mite Pests of Pepper *continued*

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Lepidopteran leafminer	Confirm 240F	tebufenozide	0.6 L/ha	12	2	Use sufficient volume of water to ensure thorough coverage. Foliar application only. Apply at first egg hatch. Maximum number of applications per crop cycle is 4, if monitoring indicates that it is required. Applications should be made a minimum of 10 days apart.
	Coragen	chlorantraniliprole	200 mL/1,000 L	12	1	Apply at egg hatch. Reapply if monitoring indicates it is necessary. Thorough coverage is important to obtain optimum control. Do not make more than 3 applications per crop cycle.
Mealybugs	Dibrom	naled	Vapour: 10 mL/100 m^3 Fog: 7–14 mL/100 m^2	48	NA	Vapour treatment: Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry. Fogging: Apply with automated fogging equipment only. All workers must vacate premises during the fogging operation. One application per crop cycle, after the last harvest at the end of the cropping cycle.
Pepper weevil *(Anthonomus eugenii)* (suppression only)	Actara 25 WG	thiamethoxam	14 g/100 L	12	1	Apply before pest reaches damaging levels. Monitor greenhouse and reapply if the pest population rebuilds to potentially damaging levels. Maximum of 3 applications per crop cycle. Actara 25 WG should be used in conjunction with a robust IPM program. This product is highly toxic to bees exposed to direct treatment or to residues on crops.

Pepper weevil *(Anthonomus eugenii)* (suppression only) *Continued*	Dibrom	naled	Vapour: 10 mL/100 m³ Fog: 7–14 mL/100 m²	48	NA	Vapour treatment: Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry. Fogging: Apply with automated fogging equipment only. All workers must vacate premises during the fogging operation. One application per crop cycle, after the last harvest at the end of the cropping cycle.
Psyllids	Avid 1.9% EC	abamectin	30 mL/100 L	Do not re-enter treated areas until sprays have dried.	3	Application should be made preferably in 2,000–4,000 L of water/ha. If volumes of water below 2,000 L must be used, apply a minimum of 600 mL Avid 1.9% EC /ha. If volumes of water greater than 4,000 L of water/ha are required for good plant coverage, apply a maximum rate of 1,200 mL Avid 1.9% EC/ha.
	Dibrom	naled	Vapour: 10 mL/100 m³ Fog: 7–14 mL/100 m²	48	NA	Vapour treatment: Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry. Fogging: Apply with automated fogging equipment only. All workers must vacate premises during the fogging operation. One application per crop cycle, after the last harvest at the end of the cropping cycle.
	Insecticidal Soap	potassium salts of fatty acids	2 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage to flowers under high-temperature conditions.
Slugs and snails	Sluggo	ferric phosphate	25–50 kg/ha (2.5–5 g/m²)	–	–	Re-apply bait as needed or at least every 2 weeks if slugs and snails continue to be a problem.
Thrips	BotaniGard ES	*Beauveria bassiana*	2 L/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.

Table 6–1. Products Registered for Insect and Mite Pests of Pepper *continued*

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Thrips *Continued*	BotaniGard WP	*Beauveria bassiana*	500–1,000 g per 400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.
	Met52	*Metarhizium anisopliae* Strain F52	0.5-5.0 L/1,000 L	0	0	Begin application during early stages of population development. Use the higher application concentration when pest pressure is high. An application interval of 5-10 days is recommended. Spray to wet all foliage, but avoid runoff. Do not apply through a thermal pulse fogger. Do not store at high temperatures, and do not mix more Met52 than can be applied within 6 hr of mixing. Do not apply fungicides near the time of application of Met52.
	Entrust 80 W	spinosad	30 g/1,000 L	12	2	For suppression only of thrips. Maximum volume that can be used is 2,000 L/ha. Apply when pest first appears. Do not apply by a fogger or mister. Monitoring is critical for proper timing of the insecticide. Three applications can be used per crop cycle.
	Success	spinosad	50 mL/1,000 L	12	2	This product is for suppression only of thrips. The maximum application volume that can be used is 2,000 L/ha. Apply when pest first appears. Do not apply by a fogger or mister. Three applications per crop cycle can be used with a minimum of 7 days between applications.
Tobacco budworm *(Heliothis virescens)*	Pylon	chlorfenapyr	30 mL/100 L	12	0	A maximum of 1 application per crop cycle is allowed. Do not apply as an ultra-low volume spray, nor through any type of irrigation system. Do not use on tomato varieties with a diameter of less than 2.5 cm when mature. Pylon is toxic to bees and other beneficial insects.

Tomato hornworm	Bioprotec CAF Aqueous Biological Insecticide	*Bacillus thuringiensis* subsp. *kurstaki*	0.9–1.8 L/1,000 L	–	0	Apply to young larvae at first signs of infestation. Repeat applications as necessary to maintain control of young larvae. The timing and number of applications will depend on foliage development and larval activity, including egg hatch, stage of larval development and population pressure.
	Pylon	chlorfenapyr	30 mL/100 L	12	0	A maximum of 1 application per crop cycle is allowed. Do not apply as an ultra-low volume spray, nor through any type of irrigation system. Do not use on tomato varieties with a diameter of less than 2.5 cm when mature. Pylon is toxic to bees and other beneficial insects.
Two-spotted spider mite	Avid 1.9% EC	abamectin	30 mL/100 L	Do not re-enter treated areas until sprays have dried.	3	Application should be made preferably in 2,000–4,000 L of water/ha. If volumes of water below 2,000 L must be used, apply a minimum of 600 mL Avid 1.9% EC /ha. If volumes of water greater than 4,000 L of water/ha are required for good plant coverage, apply a maximum rate of 1,200 mL Avid 1.9% EC/ha.
	Dibrom	naled	Vapour: 10 mL/100 m^3 Fog: 7–14 mL/100 m^2	48	NA	Vapour treatment: Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry. Fogging: Apply with automated fogging equipment only. All workers must vacate premises during the fogging operation. One application per crop cycle, after the last harvest at the end of the cropping cycle.
	DynoMite 75 WP	pyridaben	284 g/ha using 1,000 L/ha	12	3	The maximum number of applications per crop cycle is two. Apply at intervals of at least 28 days.
	Floramite SC	bifenazate	125 mL/400 L	12	1	Only two applications per crop cycle are allowed.
	Forbid 240 SC	spiromesifen	30–50 mL/100 L	12	3	The maximum number of applications per crop cycle is two.
	Insecticidal Soap	potassium salts of fatty acids	2 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage to flowers under high-temperature conditions.

Table 6–1. Products Registered for Insect and Mite Pests of Pepper *continued*

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Two-spotted spider mite *Continued*	Pylon	chlorfenapyr	20-30 mL/100 L	12	0	Use lower concentrations before populations are causing economic damage. A maximum of 1 application per crop cycle is allowed. Do not apply as an ultra-low volume spray, nor through any type of irrigation system. Do not use on tomato varieties with a diameter of less than 2.5 cm when mature. Pylon is toxic to bees and other beneficial insects.
	Shuttle 15SC	acequinocyl	0.21-0.46 L/500 L	12	1	Do not apply more than 2 applications per crop. Thorough coverage is essential for effective control. Application should be made as soon as the mite population reaches economic infestation levels. Apply the higher concentration for heavy pest populations. Allow a minimum of 21 days between applications of Shuttle 15SC.
Whiteflies	BotaniGard ES	*Beauveria bassiana*	0.5–1 L/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.
	BotaniGard WP	*Beauveria bassiana*	250–500 g/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.

Whiteflies *Continued*	Dibrom	naled	Vapour: 10 mL/100 m^3 Fog: 7–14 mL/100 m^3	48	NA	Vapour treatment: Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry. Fogging: Apply with automated fogging equipment only. All workers must vacate premises during the fogging operation. One application per crop cycle, after the last harvest at the end of the cropping cycle.
	Distance	pyriproxyfen	45 mL/100 L	12	3	The maximum number of applications per crop cycle is two. Make the 1st application when adults begin to appear.
	Forbid 240 SC	spiromesifen	30–50 mL/100 L	12	3	The maximum number of applications per crop cycle is two.
	Insecticidal Soap	potassium salts of fatty acids	1 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage to flowers under high-temperature conditions.
	Intercept 60 WP	imidacloprid	**For a transplant tray plug drench,** apply 4.1 g/1,000 seedlings in a solution application rate of 8 L/100 m^2 of seedling trays. **For mature plants,** apply 16 g in 70 L per 1,000 plants.	–	3	**Transplants:** Apply to 2–3-week-old seedlings in flats. Make one application per growing season. **Mature plants:** Applications should be made when infestation pressure surpasses threshold and beneficials are not able to maintain pest populations below damage thresholds. Do not apply more than once per season. Repellency of bumblebee pollinators and negative effects on some beneficials (e.g. *Orius* sp.) can occur.
	Kontos	spirotetramat	30-42 mL/100 L Maximum rate per single application is 300 mL/ha	12	3	Use the higher concentration for higher pest infestation levels. Interval between applications is at least 7-14 days. The maximum number of applications per cropping cycle is 3. A maximum of 900 mL of product is allowed per crop cycle. Do not exceed a spray volume of 712 L/ha (42 ml concentration) to 1,000 L/ha (30 ml concentration). Avoid application during flowering. Residues in/on pollen and nectar may harm bee brood, but the product is not acutely toxic to adult bees. The product is toxic to certain beneficials.

[1] DF = Dry Flowable; EC = Emulsifiable Concentrate; ES = Emulsifiable Suspension; F = Flowable; SC = Sprayable Concentrate; W, WP = Wettable Powder; WG = Wettable Granules; WSP = Water-Soluble Packs

[2] "–" indicates no information was provided on the product label; NA = not applicable.

Table 6–2. Products Registered for Pepper Diseases

Disease	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Bacterial blight *(Pseudomonas syringae)*	Cease	*Bacillus subtilis strain* QST 713	1.0-2.0 L/100 L water	-	0	Begin application when environmental conditions in the greenhouse are conducive to disease development. Repeat as necessary on a 7 to 10-day interval.
Bacterial canker	Kasumin 2L	kasugamycin	1.2 L/ha	12	1	Do not make more than 3 applications per season. A minimum of 7 days between applications Is required. Do not make more than 2 consecutive applications. If additional applications are needed, rotate with another product with a different mode of action that is registered for this use.
Bacterial speck *(Pseudomonas syringae)*	Cease	*Bacillus subtilis strain* QST 713	1.0-2.0 L/100 L water	-	0	Begin application when environmental conditions in the greenhouse are conducive to disease development. Repeat as necessary on a 7 to 10-day interval.
	Rhapsody ASO (aqueous suspension)	*Bacillus subtilis*	1–2 L/100 L	–	0	Apply preventively or in early stages of disease development. Repeat as necessary every 7–10 days. Maintain agitation during mixing and application to ensure uniform coverage. Do not mix in spray tank with pesticides, surfactants or fertilizers.
Bacterial spot *(Xanthomonas campestris)*	Cease	*Bacillus subtilis strain* QST 713	1.0-2.0 L/100 L water	-	0	Begin application when environmental conditions in the greenhouse are conducive to disease development. Repeat as necessary on a 7 to 10-day interval.
	Kasumin 2L	kasugamycin	1.2 L/ha	12	1	Do not make more than 3 applications per season. A minimum of 7 days between applications Is required. Do not make more than 2 consecutive applications. If additional applications are needed, rotate with another product with a different mode of action that is registered for this use.
	Rhapsody ASO (aqueous suspension)	*Bacillus subtilis*	1–2 L/100 L	–	0	Apply preventively or in early stages of disease development. Repeat as necessary every 7–10 days. Maintain agitation during mixing and application to ensure uniform coverage. Do not mix with pesticides, surfactants or fertilizers.

Botrytis grey mould	Cease	*Bacillus subtilis* strain QST 713	1.0-2.0 L/100 L water	-	0	Begin application when environmental conditions in the greenhouse are conducive to disease development. Repeat as necessary on a 7 to 10-day interval.
	Fontelis	penthiopyrad	1.25–1.75 L/ha	12	0	Begin applications prior to disease development and continue on a 7 to 10-day interval. Use higher rate and shorter interval when disease pressure is high. Make no more than 2 sequential applications before switching to a fungicide with a different mode of action.
	Prestop	*Gliocladium catenulatum*	Apply sufficient 0.5% suspension to wet plants, but not to run-off.	4	0	Repeat applications every 3 to 4 weeks. Viability of contents in unopened packets, stored under cool (approx. 4°C), dry conditions, is 12 months. Use entire contents of opened packets on the same day they are opened.
	Rhapsody ASO (aqueous suspension)	*Bacillus subtilis*	1–2 L/100 L	–	0	Apply preventively or in early stages of disease development. Repeat as necessary every 7–10 days. Maintain agitation during mixing and application to ensure uniform coverage. Do not mix in spray tank with pesticides, surfactants or fertilizers.
Damping-off in seedlings	Actinovate SP	*Streptomyces lydicus strain* WYEC 108	7.5 to 42 g/300 mL water/kg of seed	1	0	Apply through mist-type commercial seed treatment equipment, slurry, or other comparable methods that provide thorough coverage of treated seeds. Prior to planting, dissolve Actinovate SP in water and spray directly on seed.
	Maestro 80 DF	captan	1.25 kg/1,000 L, apply 50–85 L/100 m^2	48	–	Work into the upper 7.5–10 cm of soil before planting.
	Supra Captan 80 WDG	captan	Use 1.25 kg/ 1,000 L and apply at rates of 50–85 L/100 m^2.	48	–	Work into the upper 7.5–10 cm of soil before planting.
	Influence WP	garlic	10-20 kg in 1,000 L water to cover 300 m^2	Do not re-enter treated areas until sprays have dried.	0	Apply as a drench to the substrate surface at seeding. Use the higher rate under high disease pressure or when conditions are conducive to disease development.
Early blight	Fontelis	penthiopyrad	1.25–1.75 L/ha	12	0	Begin applications prior to disease development and continue on a 7 to 10-day interval. Use higher rate and shorter interval when disease pressure is high. Make no more than 2 sequential applications before switching to a fungicide with a different mode of action.

Table 6–2. Products Registered for Pepper Diseases *continued*

Disease	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
***Fusarium* spp.**	Mycostop	*Streptomyces griseoviridis*	Immediately after transplanting, apply 10–50 mg/plant or 20–100 mL/plant of 0.05% suspension.	4	0	Repeat treatments at intervals of 3–6 weeks depending on disease pressure.
	RootShield Granules	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
	RootShield HC Wettable Powder	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
	RootShield WP	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
Phytophthora sp.	Mycostop	*Streptomyces griseoviridis*	Immediately after transplanting, apply 10–50 mg/plant or 20–100 mL/plant of 0.05% suspension.	4	0	Repeat treatments at intervals of 3–6 weeks depending on disease pressure.
Powdery mildew	Actinovate	*Streptomyces lydicus*	425 g/1,100 L	1	0	Begin applications at transplant, and make subsequent applications at 7–14-day intervals. Store at 21–26°C for no more than 12 months, away from direct sunlight and heat sources.
	MilStop	potassium bicarbonate	5.6 kg/ha	4	0	Do not mix with other soluble fertilizers or pesticides; this product is not compatible with mild alkaline solutions. Addition of surfactant or wetting agent is not required.
	Nova 40 W (WSP)	myclobutanil	Apply 340 g/ha using 1,500–3,000 L water/ha.	12	3	Apply as soon as possible after initial infection and again 12 days later when disease pressure warrants control. The maximum number of applications per crop cycle is three.
	Pristine WG	boscalid + pyraclostrobin	Apply 1.2 kg/ha in a minimum water volume of 250 L/ha.	12	1	Do not apply more than once per crop cycle. Do not apply this product using any type of fogger or mister.

Powdery mildew *Continued*	Sulphur (Bartletts's Microscopic Sulphur 92%)	sulphur	543–760 g per 1,000 L/ha	24	1	A maximum of 10 applications per crop cycle is allowed. Apply on a minimum of 14-day interval.
	Sulphur - Agrotek Ascend Vaporized Sulphur	sulphur	0.4-3.2 g sulphur per 1,000 m^2 per application	Vent greenhouse for a minimum of 2 hr before re-entry. During venting, there should be a minimum of 4 air changes per hr.	-	Run the vaporizer for 1-8 hr per night and repeat 2-7 days per week. See label for general and specific instructions on vaporization of sulphur in the greenhouse.
	Switch 62.5 WG/ Palladium	cyprodinil + fludioxinil	775 g/ha	24	1	First application should be made when disease first appears; a second application should be made 7–10 days later. Make no more than 2 sequential applications before alternating with another registered fungicide with a different mode of action. Do not make more than 3 applications per crop cycle.
Pythium root rot	Actinovate SP	*Streptomyces lydicus* strain WYEC 108	420 to 840 g/ha 42 to 84 g/100 L water/1m^3 of growing media	1	0	Apply solution to the growing media. Apply Actinovate immediately after the seed is planted and then repeat application every 7 to 14 days.
	Prestop	*Gliocladium catenulatum*	Apply 125–250 mL of 0.5% suspension/ 10 L of growth media, or 100 L of 0.5% suspension/2,000 plants.	4	0	Repeat applications every 3 to 6 weeks. Viability of contents in unopened packets, stored under cool (approx. 4°C), dry conditions, is 12 months. Use entire contents of opened packets on the same day they are opened.
	Previcur N	propamocarb hydrochloride	Use 10 mL/10 L applied at a rate of 100–200 mL/plant. Use higher rate for 2nd and 3rd applications.	12	1	The maximum number of applications per crop cycle is four; no more than two applications on seedlings, and no more than two applications after transplanting. Occasional slight damage may occur following overhead drenching of recently planted seedlings.
	RootShield Granules	*Trichoderma harzianum*	Apply 55–110 g/m^3 of media using a suspension of 30–45 g/100 L	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
	RootShield HC Wettable Powder	*Trichoderma harzianum*	Apply 55–110 g/m^3 of media using a suspension of 30–45 g/100 L	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.

Table 6–2. Products Registered for Pepper Diseases *continued*

Disease	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Pythium root rot *Continued*	RootShield WP	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
Rhizoctonia solani	Prestop	*Gliocladium catenulatum*	Apply 125–250 mL of 0.5% suspension/ 10 L of growth media, or 100 L of 0.5% suspension per 2,000 plants.	4	0	Repeat applications every 3 to 6 weeks. Viability of contents in unopened packets, stored under cool (approx. 4°C), dry conditions, is 12 months. Use entire contents of opened packets on the same day they are opened.
	RootShield Granules	*Trichoderma harzianum*	Apply 600–750 g/m³ of planting mix or soil.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
	RootShield HC Wettable Powder	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
	RootShield WP	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
Root rot diseases	RootShield Granules	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
	RootShield HC Wettable Powder	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
	Supra Captan 80 WDG	captan	Use 1.25 kg/1,000 L and apply at rates of 50–85 L/100 m².	48	–	Work into the upper 7.5–10 cm of soil before planting.

[1] DF = Dry Flowable; W, WP = Wettable Powder; WDG = Water-Dispersible Granules; WG = Wettable Granules; WSP = Water-Soluble Packs

[2] "–" indicates no information was provided on the product label.

7. Lettuce

Products registered for insect and mite pests of lettuce are listed in Table 7–1, *Products Registered for Lettuce Insect and Mite Pests.* Products registered for lettuce diseases are listed in Table 7–2, *Products Registered for Lettuce Diseases.*

Table 7–1. Products Registered for Insect and Mite Pests of Lettuce

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Aphids	BotaniGard ES	*Beauveria bassiana*	0.5–1 L/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.
	BotaniGard WP	*Beauveria bassiana*	250–500 g/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.
	Insecticidal Soap	potassium salts of fatty acids	2 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage under high-temperature conditions.
	Intercept 60 WP	imidacloprid	For a transplant tray plug drench, apply 4.1 g/1,000 seedling plants.	–	28	Apply product prior to transplanting. Do not allow leachate to run out for the first 10 days after application. Do not apply more than once per crop season. Certain varieties may show sensitivity to this product and therefore, treatment of a few plants is recommended before application to the whole greenhouse.

Table 7–1. Products Registered for Insect and Mite Pests of Lettuce *continued*

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Aphids *Continued*	Kontos	spirotetramat	Apply 43–60 mL/100 L water with a maximum of 72 g a.i./ha application.	12	7	Mix with a spray adjuvant/additive having spreading and penetrating properties at an application rate of 0.11 to 0.2% v/v to maximize leaf uptake and systemicity of the active ingredient within treated plants. The adjuvant type must be one of the following: non-ionic (e.g. Agral 90 or Ag-surf), methylated seed oil (e.g. Hasten), or horticultural oil. Maximum number of applications per cropping cycle is 3. Minimum interval between applications is 7 days. Maximum product allowed per crop cycle is 900 mL/ha.
	Malathion 25 W	malathion	2.75–5.5 kg/ha	–	Leaf lettuce = 21 Head lettuce = 7	Do not apply more than twice per season. This product works more effectively if the temperature is 20°C or more.
	Malathion 85 E	malathion	735–1,345 mL/ha	–	7	Do not apply more than twice per season. This product works more effectively if the temperature is 20°C or more.
Armyworms	Malathion 85 E	malathion	735–1,345 mL/ha	–	7	Do not apply more than twice per season. This product works more effectively if the temperature is 20°C or more.
Cabbage loopers	Bioprotec 3P Dry Flowable Biological Insecticide	*Bacillus thuringiensis* subsp. *kurstaki*	0.92 kg/1,000 L	–	0	Apply to young larvae at first signs of infestation. Repeat applications as necessary to maintain control of young larvae. The timing and number of applications will depend on foliage development and larval activity, including egg hatch, stage of larval development and population pressure.
	Bioprotec CAF Aqueous Biological Insecticide	*Bacillus thuringiensis* subsp. *kurstaki*	1.8 L/1,000 L	–	0	Apply to young larvae at first signs of infestation. Repeat applications as necessary to maintain control of young larvae. The timing and number of applications will depend on foliage development and larval activity, including egg hatch, stage of larval development and population pressure.
	Confirm 240 F	tebufenozide	0.6 L/ha	12	14	Application interval is 10–14 days. Do not exceed two applications/year.
	Entrust 80 W	spinosad	72 g/1,000 L	12	2	Maximum volume that can be used is 500 L/ha. Apply when eggs hatch and first instar larvae are present. Do not apply by a fogger or mister. Monitoring is critical for proper timing of the insecticide. Three applications can be used per crop cycle.

Cabbage loopers *Continued*	Foray 48BA Aqueous Concentrate	*Bacillus thuringiensis* subsp. *kurstaki*	0.6–1.8 L in 500–1,000 L/ha	–	0	Apply at the first signs of larval infestations. Repeat applications as necessary to maintain control of young larvae. The exact timing and number of applications will depend on foliage development and larval activity, including extent of egg hatch, stage of larval development and population pressure.
	Matador 120 EC	lambda-cyhalothrin	83 mL/ha	24	3	Do not apply more than two applications per year. Best used against early stages of loopers.
	Success	spinosad	120 mL/1,000 L	12	2	The maximum application volume that can be used is 500 L/ha. Apply when eggs hatch and first instar larvae are present. Do not apply by a fogger or mister. Three applications per crop cycle can be used with a minimum of 7 days between applications.
Caterpillars	Malathion 25 W	malathion	2.75–5.5 kg/ha	–	Leaf lettuce = 21 Head lettuce = 7	Do not apply more than twice per season. This product works more effectively if the temperature is 20°C or more.
Earwigs	Insecticidal Soap	potassium salts of fatty acids	2 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage under high-temperature conditions.
Fungus gnats	Citation 75 WP	cyromazine	75 g/570 L (do not exceed 1,010 L of spray solution per ha)	12	14	No more than four applications per growing season. Allow 7 days between applications. Do not apply this product through any type of irrigation equipment. Do not allow effluent or run-off from greenhouses containing this product to enter lakes, streams, ponds or other waters.
	VectoBac 600 L	*Bacillus thuringiensis* subsp. *israelensis*	2–8 L/1,000 L	–	0	Do not mix or apply with fertilizers or fungicides containing copper or chlorine as this may neutralize the active ingredients.
Psyllids	Insecticidal Soap	potassium salts of fatty acids	2 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage under high-temperature conditions.
Slugs and snails	Ferric Phosphate	ferric phosphate	25–50 kg/ha (2.5–5 g/m²)	–	–	Re-apply bait as needed or at least every 2 weeks if slugs and snails continue to be a problem.

Table 7–1. Products Registered for Insect and Mite Pests of Lettuce *continued*

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Thrips	BotaniGard ES	*Beauveria bassiana*	2 L/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.
	BotaniGard WP	*Beauveria bassiana*	500–1,000 g/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.
	Malathion 25 W	malathion	2.75–5.5 kg/ha	–	Leaf lettuce = 21 Head lettuce = 7	Do not apply more than twice per season. This product works more effectively if the temperature is 20°C or more.
	Malathion 85 E	malathion	735–1,345 mL/ha	–	7	Do not apply more than twice per season. This product works more effectively if the temperature is 20°C or more.
Two-spotted spider mites	Insecticidal Soap	potassium salts of fatty acids	2 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage under high-temperature conditions.
	Malathion 25 W	malathion	2.75–5.5 kg/ha	–	Leaf lettuce = 21 Head lettuce = 7	Do not apply more than twice per season. This product works more effectively if the temperature is 20°C or more.
	Malathion 85 E	malathion	735–1,345 mL/ha	–	7	Do not apply more than twice per season. This product works more effectively if the temperature is 20°C or more.
Whiteflies	BotaniGard ES	*Beauveria bassiana*	0.5–1 L/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.

Whiteflies *Continued*	BotaniGard WP	*Beauveria bassiana*	250–500 g/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.
	Insecticidal Soap	potassium salts of fatty acids	1 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage under high-temperature conditions.
	Malathion 25 W	malathion	2.75–5.5 kg/ha	–	Leaf lettuce = 21 Head lettuce = 7	Do not apply more than twice per season. This product works more effectively if the temperature is 20°C or more.
	Malathion 85 E	malathion	735–1,345 mL/ha	–	7	Do not apply more than twice per season. This product works more effectively if the temperature is 20°C or more.

[1] E, EC = Emulsifiable Concentrate; ES = Emulsifiable Suspension; F = Flowable; SC = Sprayable Concentrate; W, WP = Wettable Powder

[2] "–" indicates no information was provided on the product label.

Table 7–2. Products Registered for Lettuce Diseases

Disease	Trade Name/ Formulation1	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)2	Pre-harvest Interval (days)2	Remarks
Blue mold	Revus	mandipropamid	400–600 mL/ha	12	7	Do not make more than four applications per season. Applications should begin prior to disease development and continue throughout the season on a 7 to 10-day schedule of fungicides, following the resistance management guidelines. Use a nonionic adjuvant (0.125% v/v)
Botrytis grey mould	Decree 50 WDG	fenhexamid	1.5 kg/ha	4	3	Do not make more than two applications per crop cycle.
	Prestop	*Gliocladium catenulatum*	Apply sufficient 0.5% suspension to wet plants, but not to run-off.	4	0	Repeat applications every 3 to 4 weeks. Viability of contents in unopened packets, stored under cool (approx. 4°C), dry conditions, is 12 months. Use entire contents of opened packets on the same day they are opened.

Table 7–2. Products Registered for Lettuce Diseases *continued*

Disease	Trade Name/ Formulation1	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)2	Pre-harvest Interval (days)2	Remarks
Botrytis grey mould *Continued*	Rhapsody ASO (aqueous suspension)	*Bacillus subtilis*	1–2 L/100 L	–	0	Apply preventively or in early stages of disease development. Repeat as necessary every 7–10 days. Maintain agitation during mixing and application to ensure uniform coverage. Do not mix with pesticides, surfactants or fertilizers.
	Rovral	iprodione	2 kg/ha in 2,000 L/ha	12	14	Use a high-volume sprayer. Apply a maximum of four applications per year.
Damping-off in seedlings	Actinovate SP	*Streptomyces lydicus strain* WYEC 108	7.5 to 42 g/300 mL of water/kg of seed	1	0	Apply through mist-type commercial seed treatment equipment, slurry, or other comparable methods that provide thorough coverage of treated seeds. Prior to planting, dissolve Actinovate SP in water and spray directly on seed.
Downy mildew	Revus	mandipropamid	400–600 mL/ha	12	7	Do not make more than four applications per season. Use a nonionic adjuvant (0.125% v/v).
	Rhapsody ASO (aqueous suspension)	*Bacillus subtilis*	1–2 L/100 L	–	0	Apply preventively or in early stages of disease development. Repeat as necessary every 7–10 days. Maintain agitation during mixing and application to ensure uniform coverage. Do not mix in spray tank with pesticides, surfactants or fertilizers.
Powdery mildew	Pristine WG	boscalid + pyraclostrobin	Apply 1.3–1.6 kg/ha in a minimum water volume of 250 L/ha.	12	0	Do not apply more than once per crop cycle. Do not apply this product using any type of fogger or mister.
	Rhapsody ASO (aqueous suspension)	*Bacillus subtilis*	1–2 L/100 L	–	0	Apply preventively or in early stages of disease development. Repeat as necessary every 7–10 days. Maintain agitation during mixing and application to ensure uniform coverage. Do not mix with pesticides, surfactants or fertilizers.

Powdery mildew *Continued*	Switch 62.5 WG/ Palladium	cyprodinil + fludioxinil	775 g/ha	12	1	First application should be made when disease first appears; a second application should be made 7–10 days later. Make no more than 2 sequential applications before alternating with another registered fungicide with a different mode of action. Do not make more than 3 applications per crop cycle.
Pythium root rot	Actinovate SP	*Streptomyces lydicus strain* WYEC 108	420 to 840 g/ha 42 to 84 g/ 100 L of water/m^3 of growing media	1	0	Apply solution to the growing media. Apply Actinovate immediately after the seed is planted and then repeat application every 7 to 14 days.
	Prestop	*Gliocladium catenulatum*	Apply 125–250 mL of 0.5% suspension/10 L of growth media, or 100 L of 0.5%. suspension per 2,000 plants.	4	0	Repeat applications every 3 to 6 weeks. Viability of contents in unopened packets, stored under cool (approx. 4°C), dry conditions, is 12 months. Use entire contents of opened packets on the same day they are opened.
Rhizoctonia solani	Prestop	*Gliocladium catenulatum*	Apply 125–250 mL of 0.5% suspension/10 L of growth media, or 100 L of 0.5% suspension per 2,000 plants.	4	0	Repeat applications every 3 to 6 weeks. Viability of contents in unopened packets, stored under cool (approx. 4°C), dry conditions, is 12 months. Use entire contents of opened packets on the same day they are opened.
Sclerotinia rot	Rhapsody ASO (aqueous suspension)	*Bacillus subtilis*	1–2 L/100 L	–	0	Apply preventively or in early stages of disease development. Repeat as necessary every 7–10 days. Maintain agitation during mixing and application to ensure uniform coverage. Do not mix with pesticides, surfactants or fertilizers.

[1] WDG = Water-Dispersible Granules; WG = Wettable Granules

[2] "–" indicates no information was provided on the product label.

8. Eggplants

Products registered for insect and mite pests of eggplant are listed in Table 8–1, *Products Registered for Insect and Mite Pests of Eggplant*. Products registered for eggplant diseases are listed in Table 8–2, *Products Registered for Eggplant Diseases*.

Table 8–1. Products Registered for Insect and Mite Pests of Eggplant

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Alfalfa looper *(Autographa californica)*	Pylon	chlorfenapyr	30 mL/100 L	12	0	A maximum of 1 application per crop cycle is allowed. Do not apply as an ultra-low volume spray, nor through any type of irrigation system. Pylon is toxic to bees and other beneficial insects.
Aphids	BotaniGard ES	*Beauveria bassiana*	0.5–1 L/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.
	BotaniGard WP	*Beauveria bassiana*	250–500 g/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.
	Dibrom	naled	Vapour: 10 mL/100 m^3 Fog: 7–14 mL/100 m^2	48	NA	Vapour treatment: Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry. Fogging: Apply with automated fogging equipment only. All workers must vacate premises during the fogging operation. One application per crop cycle, after the last harvest at the end of the cropping cycle.

Table 8–1. Products Registered for Insect and Mite Pests of Eggplant *continued*

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Aphids *Continued*	Endeavor 50 WG	pymetrozine	Apply 100–200 g/ha in a minimum of 1,000 L/ha.	12	3	Do not exceed two applications per crop cycle. Do not apply more than three applications per greenhouse per year in greenhouses with multiple crop cycles. Do not re-apply for at least 7 days. On hard-to-wet plants add a nonionic or organosilicone-based surfactant to improve coverage.
	Insecticidal Soap	potassium salts of fatty acids	2 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage to flowers under high-temperature conditions.
	Intercept 60 WP	imidacloprid	16 g in 70 L/1,000 plants	–	3	**For mature plants in production house.** **Do not apply as a foliar application, and do not apply** more than once per season. Applications should be made when infestation pressure surpasses threshold and beneficials are not able to maintain pest populations below damage thresholds. Repellency of bumblebee pollinators and negative effects on some beneficials (e.g. Orius sp.) can occur.
	Kontos	spirotetramat	30-42 mL/100 L Maximum rate per single application is 300 mL/ha	12	3	Use the higher concentration for higher pest infestation levels. Interval between applications is at least 7-14 days. The maximum number of applications per cropping cycle is 3. A maximum of 900 mL of product is allowed per crop cycle. Do not exceed a spray volume of 712 L/ha (42 ml concentration) to 1,000 L/ha (30 ml concentration).
Cabbage loopers	Bioprotec CAF Aqueous Biological Insecticide	*Bacillus thuringiensis* subsp. *kurstaki*	1.8 L/1,000 L	–	0	Apply to young larvae at first signs of infestation. Repeat applications as necessary to maintain control of young larvae. The timing and number of applications will depend on foliage development and larval activity, including egg hatch, stage of larval development and population pressure.
	Coragen	chlorantraniliprole	125 mL/1,000 L	12	1	Begin applications when treatment thresholds have been reached. Thorough coverage is required to obtain optimum control. Repeat applications if monitoring indicates it is necessary. Do not make more than 3 applications per crop cycle.

Cabbage loopers *Continued*	Entrust 80 W	spinosad	72 g/1,000 L	12	2	The maximum volume of diluted product that can be used is 1,000 L/ha. Apply when eggs hatch and first-instar larvae are present. Do not apply by a fogger or mister. Monitoring is critical for proper timing of the insecticide. Three applications can be used per crop cycle with a minimum of 7 days between applications.
	Pylon	chlorfenapyr	30 mL/100 L	12	0	A maximum of 1 application per crop cycle is allowed. Do not apply as an ultra-low volume spray, nor through any type of irrigation system. Pylon is toxic to bees and other beneficial insects.
	Success	spinosad	120 mL/1,000 L	12	2	The maximum application volume that can be used is 1,000 L/ha. Apply when eggs hatch and first instar larvae are present. Do not apply by a fogger or mister. Three applications per crop cycle can be used with a minimum of 7 days between applications.
Earwigs	Insecticidal Soap	potassium salts of fatty acids	2 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage to flowers under high-temperature conditions.
European corn borer	Entrust 80 W	spinosad	30 g/1,000 L	12	2	The maximum volume that can be used is 2,000 L/ha. Apply when eggs hatch and first instar larvae are present. Do not apply by a fogger or mister. Monitoring is critical for proper timing of the insecticide. Three applications can be used per crop cycle.
Fungus gnats	VectoBac 600 L	*Bacillus thuringiensis* subsp. *israelensis*	2–8 L/1,000 L	–	0	Do not mix and apply with fertilizers or fungicides containing copper or chlorine as this may neutralize the active ingredients.
Leafrollers	Dibrom	naled	Vapour: 10 mL/100 m^3 Fog: 7–14 mL/100 m^2	48	NA	Vapour treatment: Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry. Fogging: Apply with automated fogging equipment only. All workers must vacate premises during the fogging operation. One application per crop cycle, after the last harvest at the end of the cropping cycle.

Table 8–1. Products Registered for Insect and Mite Pests of Eggplant *continued*

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Lepidopteran leafminer	Confirm 240F	tebufenozide	0.6 L/ha	12	2	Use sufficient volume of water to ensure thorough coverage. Foliar application only. Apply at first egg hatch. Maximum number of applications per crop cycle is 4, if monitoring indicates that it is required. Applications should be made a minimum of 10 days apart.
	Coragen	chlorantraniliprole	200 mL/1,000 L	12	1	Apply at egg hatch. Reapply if monitoring indicates it is necessary. Thorough coverage is important to obtain optimum control. Do not make more than 3 applications per crop cycle.
Mealybugs	Dibrom	naled	Vapour: 10 mL/100 m^3 Fog: 7–14 mL/100 m^2	48	NA	Vapour treatment: Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry. Fogging: Apply with automated fogging equipment only. All workers must vacate premises during the fogging operation. One application per crop cycle, after the last harvest at the end of the cropping cycle.
Psyllids	Insecticidal Soap	potassium salts of fatty acids	2 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage to flowers under high-temperature conditions.
Slugs & snails	Ferric Phosphate	ferric phosphate	25–50 kg/ha (2.5–5 g/m^2)	–	–	Re-apply bait as needed or at least every 2 weeks if slugs and snails continue to be a problem.
Thrips	BotaniGard ES	*Beauveria bassiana*	2 L/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.

Thrips *Continued*	BotaniGard WP	*Beauveria bassiana*	500–1,000 g/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.
	Entrust 80 W	spinosad	30 g/1,000 L	12	2	For suppression only. The maximum volume that can be used is 1,000 L/ha. Apply when eggs hatch and first instar larvae are present. Do not apply by a fogger or mister. Monitoring is critical for proper timing of the insecticide. Three applications can be used per crop cycle.
	Success	spinosad	50 mL/1,000 L	12	2	This product is for suppression only of thrips. The maximum application volume that can be used is 2,000 L/ha. Apply when pest first appears. Do not apply by a fogger or mister. Three applications per crop cycle can be used with a minimum of 7 days between applications.
Tobacco budworm *(Heliothis virescens)*	Pylon	chlorfenapyr	30 mL/100 L	12	0	A maximum of 1 application per crop cycle is allowed. Do not apply as an ultra-low volume spray, nor through any type of irrigation system. Do not use on tomato varieties with a diameter of less than 2.5 cm when mature. Pylon is toxic to bees and other beneficial insects.
Tomato hornworm	Bioprotec 3P Dry Flowable Biological Insecticide	*Bacillus thuringiensis* subsp. *kurstaki*	0.46–0.92 kg per 1,000 L	–	0	Apply to young larvae at first signs of infestation. Repeat applications as necessary to maintain control of young larvae. The timing and number of applications will depend on foliage development and larval activity, including egg hatch, stage of larval development and population pressure.
	Pylon	chlorfenapyr	30 mL/100 L	12	0	A maximum of 1 application per crop cycle is allowed. Do not apply as an ultra-low volume spray, nor through any type of irrigation system. Do not use on tomato varieties with a diameter of less than 2.5 cm when mature. Pylon is toxic to bees and other beneficial insects.

Table 8–1. Products Registered for Insect and Mite Pests of Eggplant *continued*

Pest	Trade Name/ Formulation[1]	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[2]	Pre-harvest Interval (days)[2]	Remarks
Two-spotted spider mites	Insecticidal Soap	potassium salts of fatty acids	2 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage to flowers under high-temperature conditions.
	Dibrom	naled	Vapour: 10 mL/100 m^3 Fog: 7–14 mL/100 m^2	48	NA	Vapour treatment: Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry. Fogging: Apply with automated fogging equipment only. All workers must vacate premises during the fogging operation. One application per crop cycle, after the last harvest at the end of the cropping cycle.
	Floramite SC	bifenazate	125 mL/400 L	12	1	Only two applications per crop cycle are allowed.
	Pylon	chlorfenapyr	20-30 mL/100 L	12	0	Use lower concentrations before populations are causing economic damage. A maximum of 1 application per crop cycle is allowed. Do not apply as an ultra-low volume spray, nor through any type of irrigation system. Do not use on tomato varieties with a diameter of less than 2.5 cm when mature. Pylon is toxic to bees and other beneficial insects.
	Shuttle 15SC	acequinocyl	0.21-0.46 L/500 L	12	1	Do not apply more than 2 applications per crop. Thorough coverage is essential for effective control. Application should be made as soon as the mite population reaches economic infestation levels. Apply the higher concentration for heavy pest populations. Allow a minimum of 21 days between applications of Shuttle 15SC.
Whiteflies	BotaniGard ES	*Beauveria bassiana*	0.5–1 L/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.

Whiteflies *Continued*	BotaniGard WP	*Beauveria bassiana*	250–500 g/400 L	4	0	High pest populations may require application at 2–5-day intervals. Do not mix more BotaniGard than can be sprayed in 1 day. Spray to wet, but avoid run-off. Do not mix with any fungicide, insecticide or adjuvant. Store at 25°C for no more than 9 months, or at 35°C for no more than 1 month.
	Dibrom	naled	Vapour: 10 mL/100 m^3 Fog: 7–14 mL/100 m^2	48	NA	Vapour treatment: Apply using a squeeze bottle only. Do not apply using a paintbrush or any other method. Apply to cold pipes only. Do not apply to hot pipes. Avoid over treatment and direct application to plants as plant injury may result. Greenhouses must be fully ventilated before re-entry. Fogging: Apply with automated fogging equipment only. All workers must vacate premises during the fogging operation. One application per crop cycle, after the last harvest at the end of the cropping cycle.
	Distance	pyriproxyfen	45 mL/100 L	12	3	The maximum number of applications per crop cycle is two. Make the first application when adults begin to appear.
	Insecticidal Soap	potassium salts of fatty acids	1 L/100 L	–	5	Apply when insects occur and repeat as needed. This product may cause damage to flowers under high-temperature conditions.
	Intercept 60 WP	imidacloprid	16 g in 70 L per 1,000 plants	–	3	**For mature plants in production house.** **Do not apply as a foliar application. Do not apply** more than once per season. Applications should be made when infestation pressure surpasses threshold and beneficials are not able to maintain pest populations below damage thresholds. Repellency of bumblebee pollinators and negative effects on some beneficials (e.g. *Orius* sp.) can occur.
	Kontos	spirotetramat	30-42 mL/100 L Maximum rate per single application is 300 mL/ha	12	3	Use the higher concentration for higher pest infestation levels. Interval between applications is at least 7-14 days. The maximum number of applications per cropping cycle is 3. A maximum of 900 mL of product is allowed per crop cycle. Do not exceed a spray volume of 712 L/ha (42 ml concentration) to 1,000 L/ha (30 ml concentration).

[1] ES = Emulsifiable Suspension; SC = Sprayable Concentrate; WG = Wettable Granules; WP = Wettable Powder

[2] "–" indicates no information was provided on the product label; NA = not applicable.

Table 8–2. Products Registered for Eggplant Diseases

Disease	Trade Name/ Formulation	Common Name or Active Ingredient	Rate	Re-entry Interval (hr)[1]	Pre-harvest Interval (days)[1]	Remarks
Bacterial blight *(Pseudomonas syringae)*	Cease	*Bacillus subtilis strain* QST 713	1.0-2.0 L/100 L water	-	0	Begin application when environmental conditions in the greenhouse are conducive to disease development. Repeat as necessary on a 7 to 10-day interval.
	Rhapsody ASO (aqueous suspension)	*Bacillus subtilis*	1–2 L/100 L	–	0	Apply preventively or in early stages of disease development. Repeat as necessary every 7–10 days. Maintain agitation during mixing and application to ensure uniform coverage. Do not mix with pesticides, surfactants or fertilizers.
Bacterial canker	Kasumin 2L	kasugamycin	1.2 L/ha	12	1	Do not make more than 3 applications per season. A minimum of 7 days between applications is required. Do not make more than 2 consecutive applications. If additional applications are needed, rotate with another product with a different mode of action that is registered for this use.
Bacterial spot *(Xanthomonas campestris pv. vesicatoria)*	Kasumin 2L	kasugamycin	1.2 L/ha	12	1	Do not make more than 3 applications per season. A minimum of 7 days between applications is required. Do not make more than 2 consecutive applications. If additional applications are needed, rotate with another product with a different mode of action that is registered for this use.
Botrytis grey mould	Cease	*Bacillus subtilis strain* QST 713	1.0-2.0 L/100 L water	-	0	Begin application when environmental conditions in the greenhouse are conducive to disease development. Repeat as necessary on a 7 to 10-day interval.
	Rhapsody ASO (aqueous suspension)	*Bacillus subtilis*	1–2 L/100 L	–	0	Apply preventively or in early stages of disease development. Repeat as necessary every 7–10 days. Maintain agitation during mixing and application to ensure uniform coverage. Do not mix with pesticides, surfactants or fertilizers.
Damping-off in seedlings	Actinovate SP	Streptomyces lydicus strain WYEC 108	7.5 to 42 g/300 mL of water/kg of seed	1	0	Apply through mist-type commercial seed treatment equipment, slurry, or other comparable methods that provide thorough coverage of treated seeds. Prior to planting, dissolve Actinovate SP in water and spray directly on seed.

Fusarium spp.	RootShield WP	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
Powdery mildew	Sulphur - Agrotek Ascend Vaporized Sulphur	sulphur	0.4-3.2 g of sulphur/1,000 m² per application	Vent greenhouse for a minimum of 2 hr before re-entry. During venting, there should be a minimum of 4 air changes per hr.	–	Run the vaporizer for 1-8 hr per night and repeat 2-7 days per week. See label for general and specific instructions on vaporization of sulphur in the greenhouse.
Pythium root rot	Actinovate SP	*Streptomyces lydicus strain* WYEC 108	420 to 840 g/ha 42 to 84 g/100 L of water/1m³ of growing media	1	0	Apply solution to the growing media. Apply Actinovate immediately after the seed is planted and then repeat application every 7 to 14 days.
	Previcur N	propamocarb hydrochloride	Use 10 mL/10 L of water and apply this solution at a rate of 100–200 mL/plant. Use higher rate for 2nd and 3rd applications.	12	1	A maximum of four applications per crop cycle is allowed — no more than two applications on seedlings and no more than two applications after transplanting. Occasional slight damage may occur following overhead drenching of recently planted seedlings.
	RootShield WP	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.
Rhizoctonia spp.	RootShield WP	*Trichoderma harzianum*	Apply 55–110 g/m³ of media using a suspension of 30–45 g/100 L.	4	–	This product is effective when the root zone temperature exceeds 10°C and the media pH is neutral or acidic.

[1] "–" indicates no information was provided on the product label.

9. Biological Control Agents Used In Greenhouse Vegetable Crops

Greenhouse vegetable growers use biological control (biocontrol) agents as an integral part of their IPM programs for managing insect and mite pests. Table 9-1 lists commercially available bio biocontrol agents for major pest species in greenhouse vegetables.

Table 9-1. Biocontrol Agents for Major Greenhouse Pests

Pests	Biocontrol Agent
Aphids: various species Foxglove aphid *(Aulacorthum solani)* Green peach aphid *(Myzus persicae)* Melon aphid *(Aphis gossypii)* Potato aphid *(Macrosiphum euphorbiae)*	*Aphidius spp.* (parasitic wasps)* *Aphidoletes aphidimyza* (predatory midge)** Lacewings** Ladybeetles (*Hippodamia* sp.)**
Caterpillars (cabbage loopers, European corn borers)	*Bacillus thuringiensis* subsp. *kurstaki* (bacterium sold as DiPel, Foray, etc.)*** *Trichogramma* spp. (parasitic wasps)*
Fungus gnat (*Bradysia* and *Corynoptera* spp.)	*Dalotia coriaria* (predatory beetle)** *Bacillus thuringiensis* subsp. *israelensis* (bacterium sold as VectoBac)*** *Gaeolaelaps gillespiei* (predatory mite)** *Steinernema* sp. (nematode)** *Stratiolaelaps scimitus* (predatory mite)**
Leafminer (*Liriomyza* spp.)	*Dacnusa sibirica* (parasitic wasp)* *Diglyphus isaea* (parasitic wasp)*
Spider mite *(Tetranychus urticae)*	*Amblyseius* spp. (predatory mite)** *Feltiella acarisuga* (predatory midge)** *Phytoseiulus persimilis* (predatory mite)** *Stethorus punctillum* (predatory beetle)**

Table 9–1. Biocontrol Agents for Major Greenhouse Pests *continued*

Pests	Biocontrol Agent
Whitefly *(Trialeurodes vaporariorum* or *Bemisia* spp.)	*Delphastus catalinae* (predatory beetle)** *Dicyphus hesperus* (predatory bug)** *Encarsia formosa* (parasitic wasp)* *Eretmocerus eremicus* (parasitic wasp)*
Western flower thrips *(Frankliniella occidentalis)*	*Amblydromalus limonicus* (predatory mite)** *Amblyseius* spp. (predatory mites)** *Dalotia coriaria* (predatory beetle)** *Neoseiulus cucumeris* (predatory mite)** *Orius* spp. (predatory bug)** *Steinernema feltiae* (nematode)** *Stratiolaelaps scimitus* or *Gaeolaelaps gillespiei* (predatory mite)**

* Parasitoids: These usually require only one host for completion of development, often killing it by living on or in its body.
** Predators: These feed on their prey (pest) by catching them but otherwise live independently of them. They must consume more than one individual to reach maturity.
*** Entomopathogen

Caution is required when using pesticides along with biocontrols because most pesticides are harmful to beneficial insects. Using even one application of harmful pesticide can prevent any further use of biocontrol agents for an extended period of time. Check the following websites for information on compatibility of pesticides with biocontrols:

1. http://www.biobest.be/neveneffecten/3/3/
2. http://www.koppert.mobi/en/side_effects/C/

10. Appendices

Appendix A. Ontario Ministry of Agriculture, Food and Rural Affairs Greenhouse Vegetable Staff

Gillian Ferguson
Greenhouse Vegetable IPM Specialist
Greenhouse and Processing Crops Research Centre
2585 County Road 20
Harrow, ON N0R 1G0
Tel: 519-738-1258
Fax: 519-738-4564
Email: gillian.ferguson@ontario.ca

Shalin Khosla
Greenhouse Vegetable Specialist
Greenhouse and Processing Crops Research Centre
2585 County Road 20
Harrow, ON N0R 1G0
Tel: 519-738-1257
Fax: 519-738-4564
Email: shalin.khosla@ontario.ca

Agricultural Information Contact Centre
Provides province-wide, toll-free technical and business information to commercial farms, agri-businesses and rural businesses
1 Stone Road West
Guelph, ON N1G 4Y2
Tel: 1-877-424-1300
Fax: 519-826-3442
Email: ag.info.omafra@ontario.ca

A complete list of Ontario Ministry of Agriculture, Food and Rural Affairs staff is available on the OMAFRA website at www.ontario.ca/crops.

Appendix B. Diagnostic Services

Samples for disease diagnosis, insect or weed identification, nematode counts and Verticillium testing can be sent to:

Pest Diagnostic Clinic
Laboratory Services Division
University of Guelph
95 Stone Road West
Guelph, ON N1H 8J7
Tel: 519-767-6299
Fax: 519-767-6240
Email: aflinfo@uoguelph.ca
Website: www.guelphlabservices.com

Payment must accompany samples at the time of submission. Submission forms are at www.guelphlabservices.com/AFL/submit_samples.aspx.

How to Sample for Nematodes

Soil

When to Sample

Soil and root samples can be taken at any time of the year that the soil is not frozen. In Ontario, nematode soil population levels are generally at their highest in May and June and again in September and October.

How to Sample Soil

Use a soil sampling tube, trowel or narrow-bladed shovel to take samples. Sample soil to a depth of 20–25 cm. If the soil is bare, remove the top 2 cm prior to sampling. A sample should consist of 10 or more subsamples combined. Mix well in a clean pail or plastic bag. Then take a sample of 0.5–1 L from this. No one sample should represent more than 2.5 ha.

Sampling Pattern

If living crop plants are present in the sample area, take samples within the row and from the area of the feeder root zone (with trees, this is the drip line).

Number of Subsamples

Based on the total area sampled:

500 m^2	10 subsamples
500 m^2–0.5 ha	25 subsamples
0.5 ha–2.5 ha	50 subsamples

Roots

From small plants, sample the entire root system plus adhering soil. For large plants, 10–20 g, dig fresh weight from the feeder root zone and submit.

Problem Areas

Take soil and root samples from the margins of the problem area where the plants are still living. If possible, also take soil and root samples from healthy areas in the same field.

Sample Handling

Soil Samples

Place soil samples in plastic bags as soon as possible after collecting.

Root Samples

Place root samples in plastic bags and cover with moist soil from the sample area.

Storage

Store samples at 5–10°C and do not expose them to direct sunlight or extreme heat or cold (freezing). Only living nematodes can be counted. Accurate counts depend on proper handling of samples.

Submitting Plant for Disease Diagnosis or Identification

Sample Submission Forms

Forms can be obtained from the Laboratory Services website at www.guelphlabservices.com, your local Ontario Ministry of Agriculture, Food and Rural Affairs office, or see page 80. Carefully fill in all of the categories on the form. In the space provided, draw the most obvious symptom and the pattern of the disease in the field. It is important to include the cropping history of the area for the past three years and this year's pesticide use records.

Choose a complete, representative sample showing early symptoms. Submit as much of the plant as is practical, including the root system, or several plants showing a range of symptoms. If symptoms are general, collect the sample from an area where they are of intermediate severity. Completely dead material is usually inadequate for diagnosis.

With plant specimens submitted for identification, include at least a 20–25 cm sample of the top portion of the stem with lateral buds, leaves, flowers or fruits in identifiable condition. Wrap plants in newspaper and put in a plastic bag. Tie the root system off in a separate plastic bag to prevent it from drying out and to prevent the soil from contaminating the leaves. Do *not* add moisture, as this encourages decay in transit. Cushion specimens and pack them in a sturdy box to avoid damage during shipping. Avoid leaving specimens to bake or freeze in a vehicle or in a location where they could deteriorate.

Delivery

Deliver samples to the Pest Diagnostic Clinic as soon as possible by first class mail or by courier at the beginning of the week.

Submitting Insect Specimens for Identification

Collecting Samples

Place dead, hard-bodied insects in vials or boxes and cushion with tissues or cotton. Place soft-bodied insects and caterpillars in vials containing alcohol. Do not use water, as this results in rot. Do not tape insects to paper or send them loose in an envelope.

Place live insects in a container with enough plants for them to feed on during transit. Be sure to write "live" on the outside of the container.

Appendix C. Other Contacts

AGRICULTURE & AGRI-FOOD CANADA RESEARCH CENTRES

www.agr.gc.ca/index_e.php

Greenhouse and Processing Crops Centre

2585 County Road 20
Harrow, ON N0R 1G0
Tel: 519-738-2251

Southern Crop Protection and Food Research Centre

1391 Sandford Street
London, ON N5V 4T3
Tel: 519-457-1470

Vineland Research Farm

4902 Victoria Avenue North
Vineland, ON L0R 2E0
Tel: 905-562-4113

CANADIAN FOOD INSPECTION AGENCY REGIONAL OFFICES (PLANT PROTECTION)

www.inspection.gc.ca/english/toce.shtml

Belleville

345 College Street East
Belleville, ON K8N 5S7
Tel: 613-969-3333

Brantford

625 Park Road North, Suite 6
Brantford, ON N3T 5P9
Tel: 519-753-3478

Hamilton

709 Main Street West, Suite 101
Hamilton, ON L8S 1A2
Tel: 905-572-2201

London

19-100 Commissioners Road East
London, ON N5Z 4R3
Tel: 519-691-1300

Ottawa District

38 Auriga Drive, Unit 8
Ottawa, ON K2E 8A5
Tel: 613-274-7374, ext. 221

St. Catharines

395 Ontario Street, Box 19
St. Catharines, ON L2N 7N6
Tel: 905-937-8232

Toronto

1124 Finch Avenue West, Unit 2
Downsview, ON M3J 2E2
Tel: 416-665-5055

UNIVERSITY OF GUELPH

Main Campus

Guelph, ON N1G 2W1
Tel: 519-824-4120
www.uoguelph.ca

Alfred Campus

Alfred, ON K0B 1A0
Tel: 613-679-2218
Fax: 613-679-2423
www.alfredc.uoguelph.ca

Kemptville Campus

Kemptville, ON K0G 1J0
Tel: 613-258-8336
Fax: 613-258-8384
www.kemptvillec.uoguelph.ca

Ridgetown Campus

Ridgetown, ON N0P 2C0
Tel: 519-674-1500
www.ridgetownc.on.ca

Department of Plant Agriculture

www.plant.uoguelph.ca

Department of Plant Agriculture, Guelph

50 Stone Road West
Guelph, ON N1G 2W1
Tel: 519-824-4120, ext. 56083
Fax: 519-763-8933

Department of Plant Agriculture, Simcoe

1283 Blueline Road, Box 587
Simcoe, ON N3Y 4N5
Tel: 519-426-7127
Fax: 519-426-1225

Department of Plant Agriculture, Vineland

Box 7000, 4890 Victoria Avenue North
Vineland Station, ON L0R 2E0
Tel: 905-562-4141
Fax: 905-562-3413

Lab Services Division

www.uoguelph.ca/labserv
P.O. Box 3650, 95 Stone Road West
Guelph, ON N1H 8J7
Tel: 519-767-6299
Fax: 519-767-6240

Trace Organics and Pesticides

Tel: 519-767-6485
Fax: 519-767-6240

Pest Diagnostic Clinic

Tel: 519-767-6256
Fax: 519-767-6240

VINELAND RESEARCH AND INNOVATION CENTRE

4890 Victoria Avenue North
Vineland Station, ON L0R 2E0
Tel: 905-562-0320
Fax: 905-562-0084
www.vinelandontario.ca

Appendix D. Pesticide Groups Based on Sites of Action

Insecticides and Miticides

The classification scheme listed below is adapted from information developed by the Insecticide Resistance Action Committee Mode of Action Working Group. Products with the same group number have a similar mode of action. For details on this classification system, see http://www.irac-online.org/eClassification/.

Group #	Primary Site of Action	Group Name	Product Name(s)
1B	Acetylcholinesterase inhibitor Nerve action	organophosphate	DDVP 20% EC, Diazinon 500 EC, Dibrom, Malathion 25 W, Malathion 85 E
2A	GABA-gated chloride channel agonists Nerve action	chlorinated cyclodienes	Thionex 50 W, Thionex EC
3	Sodium channel modulators Nerve action	pyrethroids, pyrethrins	Ambush 50 EC, Matador 120 EC, Pounce 384 EC
4	Nicotinic acetylcholine receptor agonists Nerve action	neonicotinoids	Actara 25 WG, Intercept 60 WP, Tristar 70 WSP
5	Nicotinic acetylcholine receptor (allosteric) Nerve action	spinosyns	Entrust 80 W, Success
6	Chloride channel activators Nerve and muscle action	avermectins	Avid 1.9% EC
7C	Juvenile hormone mimics Growth regulation	pyriproxyfen	Distance
9B	Selective homopteran feeding blockers	pymetrozine	Endeavor 50 WG
9C	Nerve action Modulators of Chordotonal Organs	flonicamid	Beleaf 50 SG
11	Microbial disruptors of insect midgut membranes	Bacillus thuringiensis	Bioprotec 3P, Bioprotec CAF, DiPel 2X DF, DiPel WP, Foray 48BA, VectoBac 600 L

Insecticides and Miticides *continued*

Group #	Primary Site of Action	Group Name	Product Name(s)
12B	Inhibitors of mitochondrial ATP synthase Energy metabolism	organotin miticides	Vendex 50 WP
13	Energy metabolism - Uncouplers of oxidative phosphorylation via disruption of the proton gradient	chlorfenapyr	Pylon
17	Moulting disruptor Growth regulation	cyromazine	Citation 75 WP
18	Ecdysone receptor agonists Growth regulation	diacylhydrazine	Confirm 240 F
20B	Energy metabolism Mitochondrial complex III electron transport inhibitors	acequinocyl	Shuttle 15 SC
21A	Mitochondrial complex 1 electron transport inhibitors (METI) Energy metabolism	METI insecticides and acaricides	DynoMite 75 WP
23	Inhibitors of acetyl CoA carboxylase Lipid synthesis, growth regulation	tetronic and tetramic acid derivatives	Forbid 240 SC, Kontos
28	Ryanodine receptor modulator Nerve and muscle action	chlorantraniliprole	Coragen
Un	Compounds of unknown or uncertain mode of action[1]	bifenazate	Floramite SC

[1] A compound with an unknown mode of action or where consensus does not exist on mode of action or an unknown mode of toxicity will be held in category "un" until evidence becomes available to enable that compound to be assigned to a more appropriate mode of action class.

Fungicides

This classification scheme is adapted from information developed by the Fungicide Resistance Action Committee to distinguish fungicide groups according to their cross-resistance behaviour. M = multi-site inhibitor, U = unknown mode of action and unknown resistance risk, NC = not classified. For further details on this classification system, see www.frac.info/publication/anhang/2014%20FRAC%20Code%20List.pdf.

Group #	Primary Site of Action	Group Name	Product Name(s)	Risk of Developing Resistance
2	Cell division, DNA & RNA synthesis & metabolism	dicarboximides	Rovral 50 WP	Medium to high
3	C14-demethylase in sterol biosynthesis	DMI (demethylationinhibitor) fungicides	Nova 40 W	Medium
4	RNA synthesis	PA (phenylamide) fungicides	Ridomil Gold 480 EC or Ridomil Gold 480 SL	High
7	Fungal respiration — complex II: succinate dehydrogenase	SDHI (succinate dehydrogenase inhibitors)	Fontelis, Pristine WG (boscalid = 7 + pyraclostrobin = 11)	Medium to high
9	Methionine biosynthesis (proposed)	Anilino-pyrimidines	Scala SC, Switch (cyprodinil = 9 + fludioxinil = 12)	Medium
11	Fungal respiration — complex III: cytochrome bc1	QoI (quinone outside inhibitor) fungicides	Pristine WG (boscalid = 7 + pyraclostrobin = 11)	High
12	MAP/histidine-kinase in osmotic signal transduction	phenylpyrrole	Switch (cyprodinil = 9 + fludioxinil = 12)	Low to medium
14	Lipid peroxidation (proposed)	aromatic hydrocarbons	Botran 75 W	Low to medium
17	3-keto reductase, C4 demethylation	hydroxyanilides	Decree	Low to medium
24	Protein synthesis	hexopyranosyl antibiotic	Kasumin 2L	Resistance known in fungal and bacterial (*P. glumae*) pathogens. Medium risk. Resistance management required.
28	Cell membrane permeability, fatty acids (proposed)	carbamates	Previcur N	Low to medium
40	Phospholipid biosynthesis and cell wall deposition (proposed)	carboxylic acid amides	Revus	Low to medium

Fungicides *continued*

Group #	Primary Site of Action	Group Name	Product Name(s)	Risk of Developing Resistance
44	Microbial disrupters of pathogen cell membranes	microbial (Bacillus sp.)	Cease, Rhapsody, Taegro	Low
M1	Multi-site contact activity	inorganic	Copper Spray Fungicide, Kocide 3000	Low
M2	Multi-site contact activity	inorganic	Kumulus DF, Microthiol Disperss, Sulphur (Bartlett's Microscopic Sulphur 92%), Agrotek Ascend Vaporized Sulphur	Low
M3	Multi-site contact activity	dithiocarbamates	Manzate Pro-Stick	Low
M4	Multi-site contact activity	pthalilimides	Maestro 80 DF, Supra Captan 80 WDG	Low
NC	Unknown	diverse	Cyclone, Influence, MilStop	Unknown
P5	Host plant defence induction	plant extract	Regalia Maxx	Unknown

Appendix E. Ontario Ministry of Environment and Climate Change — Regional Contact Information

Region/County	Address	Telephone/Fax
Central Region Toronto, Halton, Peel, York, Durham, Muskoka, Simcoe	5775 Yonge Street 8th Floor Toronto, ON M2M 4J1	Tel: 416-326-6700 Toll-Free: 1-800-810-8048 Fax: 416-325-6345
West-Central Region Haldimand, Norfolk, Niagara, Hamilton-Wentworth, Dufferin, Wellington, Waterloo, Brant	Ontario Government Building 119 King Street West 12th Floor Hamilton, ON L8P 4Y7	Tel: 905-521-7640 Toll-Free: 1-800-668-4557 Fax: 905-521-7820
Eastern Region Frontenac, Hastings, Lennox & Addington, Prince Edward, Leeds & Grenville, Prescott & Russell, Stormont/Dundas & Glengarry, Haliburton, Peterborough, Kawartha Lakes, Northumberland, Renfrew, Ottawa, Lanark, District of Nipissing (Twp. of South Algonquin)	1259 Gardiners Road Unit 3 PO Box 22032 Kingston, ON K7M 8S5	Tel: 613-549-4000 Toll-Free: 1-800-267-0974 Fax: 613-548-6908
Southwestern Region Elgin, Middlesex, Oxford, Essex, Kent, Lambton, Bruce, Grey, Huron, Perth	733 Exeter Road London, ON N6E 1L3	Tel: 519-873-5000 Toll-Free: 1-800-265-7672 Fax: 519-873-5020
Northern Region (East) Manitoulin, Nipissing, Parry Sound, Sudbury, Algoma (East), Timiskaming, Sault Ste. Marie	199 Larch Street Suite 1201 Sudbury, ON P3E 5P9	Tel: 705-564-3237 Toll-Free: 1-800-890-8516 Fax: 705-564-4180
Northern Region (West) Algoma (West), Cochrane, Kenora, Rainy River, Timmins, Thunder Bay	435 James Street South Suite 331 Thunder Bay, ON P7E 6S7	Tel: 807-475-1205 Toll-Free: 1-800-875-7772 Fax: 807-475-1745
Standards Development Branch	Pesticides Section 40 St. Clair Avenue West 7th Floor Toronto, ON M4V 1L5	Tel: 416-327-5519 Fax: 416-327-2936
Approvals Branch	Pesticides Licensing 2 St. Clair Avenue West 12A Floor Toronto, ON M4V 1L5	Tel: 416-314-8001 Toll-Free: 1-800-461-6290 Fax: 416-314-8452

Appendix F. The Metric System

Metric Units

Linear Measures (length)		
10 millimetres (mm)	=	1 centimetre (cm)
100 centimetres (cm)	=	1 metre (m)
1,000 metres (m)	=	1 kilometre (km)
Square Measures (area)		
100 m x 100 m = 10,000 square metres (m^2)	=	1 hectare (ha)
100 hectares (ha)	=	1 square kilometre (km^2)
Cubic Measures (volume)		
Dry Measure		
1,000 cubic millimetres (mm^3)	=	1 cubic centimetre (cm^3)
1,000,000 cubic centimetres (cm^3)	=	1 cubic metre (m^3)
Liquid Measure		
1,000 millilitres (mL)	=	1 litre (L)
100 litres (L)	=	1 hectolitre (hL)

Weight–Volume Equivalents (for water)			
1 gram (g) = 0.001 kilograms (kg)	=	1 millilitre (mL)	= 0.001 litres (L)
10 grams (g) = 0.01 kilograms (kg)	=	10 millilitres (mL)	= 0.01 litres (L)
100 grams (g) = 0.10 kilograms (kg)	=	100 millilitres (mL)	= 0.10 litres (L)
500 grams (g) = 0.50 kilograms (kg)	=	500 millilitres (mL)	= 0.50 litres (L)
1,000 grams (g) = 1.00 kilogram (kg)	=	1,000 millilitres (mL)	= 1.00 litre (L)
Weight Measures			
1,000 milligrams (mg)	=	1 gram (g)	
1,000 grams (g)	=	1 kilogram (kg)	
1,000 kilograms (kg)	=	1 tonne (t)	
1 milligram/kilogram (mg/kg)	=	1 part per million (ppm)	
Dry–Liquid Equivalents			
1 cubic centimetre (cm^3)	=	1 millilitre (mL)	
1 cubic metre (m^3)	=	1,000 litres (L)	

Metric Conversions (approximate)		
5 millilitres (mL)	=	1 teaspoon (tsp)
15 millilitres (mL)	=	1 tablespoon (tbsp)
28.5 millilitres (mL)	=	1 fluid ounce (fl oz)

Application Rate Conversions

Metric to Imperial or U.S. (approximate)		
millilitres per hectare (mL/ha) x 0.014	=	U.S. fluid ounces per acre (fl oz/ac)
litres per hectare (L/ha) x 0.71	=	Imp. pints per acre (pt/ac)
litres per hectare (L/ha) x 0.86	=	U.S. pints per acre (pt/ac)
litres per hectare (L/ha) x 0.36	=	Imp. quarts per acre (qt/ac)
litres per hectare (L/ha) x 0.43	=	U.S. quarts per acre (qt/ac)
litres per hectare (L/ha) x 0.09	=	Imp. gallons per acre (gal/ac)
litres per hectare (L/ha) x 0.11	=	U.S. gallons per acre (gal/ac)
grams per hectare (g/ha) x 0.014	=	ounces per acre (oz/ac)
kilograms per hectare (kg/ha) x 0.89	=	pounds per acre (lb/ac)
tonnes per hectare (t/ha) x 0.45	=	tons per acre (T/ac)

Imperial or U.S. to Metric (approximate)		
Imp. fluid ounces per acre x 70	=	millilitres per hectare (mL/ha)
U.S. fluid ounces per acre x 73	=	millilitres per hectare (mL/ha)
Imp. pints per acre x 1.4	=	litres per hectare (L/ha)
U.S. pints per acre x 1.17	=	litres per hectare (L/ha)
Imp. quarts per acre x 2.8	=	litres per hectare (L/ha)
U.S. quarts per acre x 2.34	=	litres per hectare (L/ha)
Imp. gallons per acre x 11.23	=	litres per hectare (L/ha)
U.S. gallons per acre x 9.35	=	litres per hectare (L/ha)
ounces per acre x 70	=	grams per hectare (g/ha)
pounds per acre x 1.12	=	kilograms per hectare (kg/ha)
pounds per acre x 0.45	=	kilograms per acre (kg/ac)
tons per acre x 2.24	=	tonnes per hectare (t/ha)

Liquid Equivalents (approximate)		
Litres/Hectare		*Gallons/Acre*
50	=	5
100	=	10
150	=	15
200	=	20
250	=	25
300	=	30

Dry Weight Equivalents (approximate)		
Grams/Hectare		*Ounces/Acre*
100	=	1 ½
200	=	3
300	=	4 ¼
500	=	7
700	=	10
Kilograms/Hectare		*Pounds/Acre*
1.10	=	1
1.50	=	1 ¼
2.00	=	1 ¾
2.50	=	2 ¼
3.25	=	3
4.00	=	3 ½
5.00	=	4 ½
6.00	=	5 ¼
7.50	=	6 ¾
9.00	=	8
11.00	=	10
13.00	=	11 ½
15.00	=	13 ½

Conversion Tables — Metric to Imperial (approximate)

Length		
1 millimetre (mm)	=	0.04 inches (in.)
1 centimetre (cm)	=	0.40 inches (in.)
1 metre (m)	=	39.40 inches (in.)
1 metre (m)	=	3.28 feet (ft)
1 metre (m)	=	1.09 yards (yd)
1 kilometre (km)	=	0.62 mile (mi)
Area		
1 square centimetre (cm^2)	=	0.16 square inches (sq in.)
1 square metre (m^2)	=	10.77 square feet (sq ft)
1 square metre (m^2)	=	1.20 square yards (sq yd)
1 square kilometre (km^2)	=	0.39 square mile (sq mi)
1 hectare (ha)	=	107,636 square feet (sq ft)
1 hectare (ha)	=	2.5 acres (ac)
Volume (dry)		
1 cubic centimetre (cm^3)	=	0.061 cubic inches (cu ft)
1 cubic metre (m^3)	=	35.31 cubic feet (cu ft)
1 cubic metre (m^3)	=	1.31 cubic yards (cu yd)
1,000 cubic metres (m^3)	=	0.81 acre-foot (ac ft)
1 hectolitre (hL)	=	2.8 bushels (bu)
Volume (liquid)		
1 millilitre (mL)	=	0.035 fluid ounces (fl oz)
1 litre (L)	=	1.76 pints (pt)
1 litre (L)	=	0.88 quarts (qt)
1 litre (L)	=	0.22 gallons (Imp.) (gal)
1 litre (L)	=	0.26 gallons (U.S.) (gal)
Weight		
1 gram (g)	=	0.035 ounces (oz)
1 kilogram (kg)	=	2.21 pounds (lb)
1 tonne (t)	=	2,205 pounds (lb)
1 tonne (t)	=	1.10 short tons
Pressure		
1 kilopascal (kPa)	=	0.15 pounds per square inch (psi)

Speed (approximate)		
1 metre per second (m/s)	=	3.28 feet per second (ft/sec)
1 metre per second (m/s)	=	2.24 miles per hour (mph)
1 kilometre per hour (km/h)	=	0.62 miles per hour (mph)
Temperature		
°F	=	(°C × 9/5) + 32

Conversion Tables — Imperial to Metric (approximate)

Length		
1 inch (in.)	=	2.54 centimetres (cm)
1 foot (ft)	=	0.30 metres (m)
1 yard (yd)	=	0.91 metres (m)
1 mile (mi)	=	1.61 kilometres (km)
Area		
1 square foot (sq ft)	=	0.09 square metres (m^2)
1 square yard (sq yd)	=	0.84 square metres (m^2)
1 acre (ac)	=	0.40 hectares (ha)
Volume (dry)		
1 cubic yard (cu yd)	=	0.76 cubic metres (m^3)
1 bushel (bu)	=	36.37 litres (L)
Volume (liquid)		
1 fluid ounce (Imp.) (fl oz)	=	28.41 millilitres (mL)
1 pint (Imp.) (pt)	=	0.57 litres (L)
1 gallon (Imp.) (gal)	=	4.55 liters (L)
1 gallon (U.S.) (gal)	=	3.79 litres (L)
Weight		
1 ounce (oz)	=	28.35 grams (g)
1 pound (lb)	=	453.6 grams (g)
1 ton (T)	=	0.91 tonnes (t)
Pressure		
1 pound per square inch (psi)	=	6.90 kilopascals (kPa)
Temperature		
°C	=	(°F – 32) × 5/9

Abbreviations

%	=	per cent (by weight)	km	=	kilometre
ai	=	active ingredient	km/h	=	kilometres per hour
AP	=	agricultural powder	kPa	=	kilopascal
cm	=	centimetre	L	=	litre
cm^2	=	square centimetre	m	=	metre
DG	=	dispersible granular	m^2	=	square metre
DP	=	dispersible powder	mL	=	millilitre
E	=	emulsifiable	mm	=	millimetre
EC	=	emulsifiable concentrate	m/s	=	metres per second
e.g.	=	for example	SC	=	sprayable concentrate
F	=	flowable	SP	=	soluble powder
g	=	gram	t	=	tonne
Gr	=	granules, granular	W	=	wettable (powder)
ha	=	hectare	WDG	=	water dispersible granular
kg	=	kilogram	WP	=	wettable powder

Calculating Parts per Million (ppm)

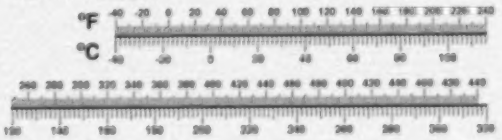
1 ppm	=	1 g active ingredient per 1,000 L water

Handy Approximate Metric Conversion Factor

litres per hectare × 0.4 = litres per acre

kilograms per hectare × 0.4 = kilograms per acre

TEMPERATURE



For exact values the formula is:
Fahrenheit to Celsius: subtract 32 from number of °F, then multiply by 5/9.
Celsius to Fahrenheit multiply °C by 9/5 then add 32.

Emergency and First-Aid Procedures for Pesticide Poisoning

For a major spill, a theft or a fire involving a pesticide, call the Ministry of the Environment and Climate Change at **1-800-268-6060.**

For pesticide poisonings and pesticide injuries, call the Poison Information Centre:

Toronto	1-800-268-9017
	1-877-750-2233 (TTY)

PREVENT ACCIDENTS

- **Read the label.** Follow all the precautions the label recommends. Read the First Aid section of the label BEFORE you begin to handle any pesticide.
- **Make sure that someone knows** pesticides you are working with and where you are.
- **Keep a file of labels and product Material Safety Data Sheets (MSDS) for the pesticides you use.**

  Make sure everyone knows where to find this in case of an emergency.
- **Post emergency numbers near all telephones.**
- **Keep clean water, paper towels, extra gloves and clean coveralls close by** in case you spill pesticide on yourself.

If someone has been working with pesticides and you see any possible symptoms of pesticide poisoning or injury, take emergency action immediately.

IF AN ACCIDENT OR POISONING HAPPENS

- Protect yourself from injury first.
- Stop the exposure to the pesticide. Move the victim away from the contaminated area.
- Check the four basic facts — identify the pesticide, the quantity, the route of entry and time of exposure.
- Call an ambulance or the Poison Information Centre.
- Start first aid. This is not a substitute for professional medical help.
- **Provide the label, MSDS sheet or container to emergency personnel** at the scene — or take it with you to the hospital. Do not transport pesticide containers in the passenger compartment of the vehicle.

FIRST AID

If a pesticide comes in contact with skin:

- remove all contaminated clothing; wash skin thoroughly with lots of soap and warm water
- dry skin well and cover with clean clothing or other clean material.

If pesticide comes in contact with eyes:

- hold eyelids open; wash the eyes with clean running water for 15 minutes or more.

If pesticide was inhaled:

- move the victim to fresh air and loosen tight clothing
- give artificial respiration if the victim is not breathing.

Do not breathe in the exhaled air from the victim — you could also be poisoned.

If a pesticide was swallowed:

- **call the Poison Information Centre IMMEDIATELY.**

Emergency numbers are listed at the front of each Bell telephone directory.

To obtain copies of other OMAFRA publications, please order:

- online at www.serviceontario.ca/publications
- by phone through the ServiceOntario Contact Centre, Monday to Friday, 8:30 AM to 5:00 PM ET
  - 416-326-5300
  - 1-800-668-9938, toll-free across Canada
  - 1-800-268-7095 (TTY), toll-free across Ontario
- in person at ServiceOntario Centres across Ontario

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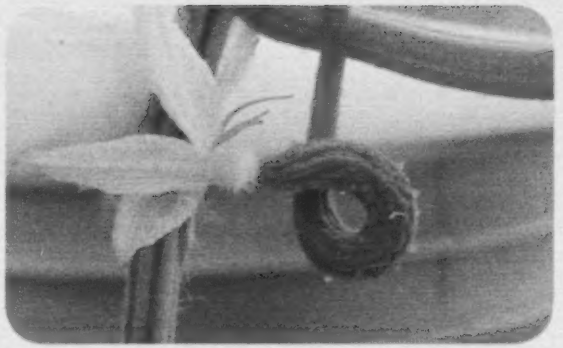

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